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A

COLLECTION,

Of SCARCE and VALUABLE

TREATISES,

UPON

METALS, MINES, *and* MINERALS.

In Four PARTS.

PART I. and II.

Containing the Art of METALS, Written originally in *Spaniſh*. By the learned ALBARO ALONSO BARBA, Director of the Mines at *Potoſi*, in the *Spaniſh Weſt-Indies*. Tranſlated by the Earl of SANDWICH, in the Year 1669.

PART III.

Containing that Invaluable PIECE of Mr G. PLATTES, *viz.* a Diſcovery of all Sorts of Mines from Gold to Coal.

PART IV.

HOUGHTON's Compleat MINER.

LONDON,
Printed by *C. Jephſon*, in *Weſt-Smithfield*,
For OLIVE PAYNE, at *Horace*'s Head in *Round-Court* in the *Strand*. MDCCXXXVIII.

THE

PREFACE

THOU *haſt now in thy Hands a Jewel ſo much eſteemed in* Spain *and the* Indies, *that there they ſell even all they have (and the Kingdom of Heaven to boot) to purchaſe it; for having this, they think that therewith they ſhall have all Things (in this World I mean) given unto them: And in that Country, I muſt tell you, it will go a great Way toward the Purchaſe of the other. Indeed there are ſome in all Nations that will ſell that they have not, nor ever ſhall have; but this was a Jewel ſo rare, that few had it to ſell, for it was concealed like the great* Arcanum, *the Philoſopher's Stone, and only traditionally delivered to the* Adepti; *but it falling into the Hands of this true Nobleman of* England, *he not envying the reſt of Mankind ſo great a Benefit, nor being willing ſo great a Treaſure ſhould be wrapt up in a Napkin, he honoured and*

and enriched our Language with it, being contented that all our Lord the King's People ſhould be Philoſophers.

Advertiſement concerning the preſent Edition.

H*Aving for ſome Years obſerved a great Demand for Books of this Kind (and for theſe Treatiſes in particular) which, by the judicious, are eſteemed as good, or better than any on the Subject, (and very rare) and finding nothing new publiſhed, was induced to the preſent Undertaking; I am informed by a Gentleman of undoubted Credit, that the Sale of* Barba's *Book is prohibited in* Spain, *under the Penalty of the Inquiſition, and is ſo ſcarce in* England, *that I am informed there is but one Copy of the* Spaniſh *Edition, which is in Sir* Hans Sloan's *Library;* Plattes's *Diſcovery is very much eſteemed, as being founded upon Experience: Alſo* Houghton *is valuable for his Laws relating to Mines, and his Explanation of the Miners Terms,* &c.

O. PAYNE.

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A
TREATISE
OF
METALS MINES, &c.

CHAP. I.

Of the Companions of Metals; and firſt of the Earth, and the ſeveral Colours thereof.

ALL the inanimate Things within the Bowels of the Earth are reducible into one of theſe four Kinds of Mixtures, *viz.* METALS, STONES, EARTH, or JUICES.

Nature produces Theſe mingled one with the other; and becauſe the Art of ſeparating of Metals cannot be put in practice without underſtanding the Nature of the other three, (as will hereafter appear) therefore I ſhall treat of Theſe a little.

By the word *Earth* I do not mean that pure and ſimple Element, whereof the Philoſophers ſay all mixed ſublunary Bodies are compoſed.

Neither do I mean that which is ſo groſs as it remains mixed with Metal, Vitriol, or other Juices.

But I mean ſuch an earthy Subſtance as neither melts in the Fire, nor diſſolves in the Water, as Metals and Juices do, nor is ſo compacted or hard as are Stones.

Some report *Ariſtotle* to have been of Opinion, that the pure elementary Earth was void of Colour. *Strabo* affirms it to be white, becauſe Aſhes are of that Colour; but the Miner may reſt ſecure, that, dig he never ſo deep, he ſhall not meet with any ſuch pure Element of Earth to make new Experiments by, becauſe it is not in the World, by Reaſon of the perpetual Mixture of the Elements one with the other.

The Colour of the pureſt Earth that hath been found, *Cardona* would have to be a very dark Grey: In the other ſorts of Earth we ſee how rich Nature hath adorned the World with Variety of Colours, cauſed by difference of Exhalation, as *Theopraſtus* ſays, or by difference of Heat, as *Ariſtotle* ſays, and both truly: For if under Earth, that hath not it's natural and proper Colour, there be found Metals, it is certain, that the Exhalations from thoſe Metals hath diſcoloured the Ground; and if there be no Metal found there, then the Diſcolouring preceeds from the conſuming Power of the Sun's Heat. Beſides, the Diſcolouring that comes by reaſon of Exhalation carries a Gliſtering and Shining along with it, and the Diſcolouring from the Sun's over-concoction only is obſcure, or iron-colour'd, or black.

From what is already ſaid, conſiderable Conjectures may be made for the finding out of Mines in the Bowels of the Earth, by the Colour of the Ground and Cliffs, or by the Tilth ploughed up upon the Mountains; as daily Experience hath ſhewn all over the Dominions of *Spain*.

CHAP. II.

Of the divers Smells of the Earth, and the Reaſon thereof.

THE Works of Nature in producing Variety of Smells of Earth, is alſo worthy of Admiration.

Ordinarily the Earth ſmells well upon the Fall of the firſt Rains after the Heat of Summer is paſt: The dry Time having baked together the moderate Humidity that was in the Earth, (which is the Cauſe from whence all good Smells proceed) and the firſt Rains diſſolving that again (which being exhaled by moderate Heat) makes the good Scent which we perceive. Some Sorts of earthen Veſſels alſo have this Privilege, as that of *Eſtremos* in *Portugal*, and of *Nata* in *Panama*, which are highly eſteemed in *Europe* for that Quality. In the famous City of *Malacca*, in the *Eaſt-Indies*, they ſay there is a Sort of earthen Veſſel that ſmells admirably, in ſo great abundance, that it is little eſteemed, and they make all their moſt ſervile Sort of Ware of it: And in ſome Mines good ſmelling Earth hath been met withal, although moſt commonly that kind of Earth is of an ill Scent. *Agricola* relates, that when *Henry* Prince of *Saxony* was in *Mariemburg*, there came ſo ſweet a Smell out of the Mine, which they called St *Sebaſtian*, that the Prince admired thereat, and ſaid, that he thought he was in *Calivet*, that famous Country of the *Indies*, which for it's rare Smells and other Excellencies hath been thought by judicious Men to be the Paradiſe wherein *Adam* of old, and the Fathers now enjoy God upon Earth. The Metal that comes out of the Mines which they call *Palos* is of a good Smell, if they light not upon ſome baſtard Mineral that accompanies, and has infected it: And this good Smell is a great Sign of the Richneſs of the Stones of that Mine, and of the Earth which they get there called *Lampos*. This Experiment is ordinary in Lead or Tin Mines; and it is uſual for the Miners to judge of their Oar by the Smell, as well as by the Taſte. Other Sorts of Metal for the moſt part have an ill Smell, either becauſe of their own natural Diſtemper, or by reaſon of their being generally mixed with Brimſtone, Copperas, or other malignant Juices.

Some do think, that, over and above what hath been ſaid, there is ſome Matter in the

Bowels of the Earth ſo ſtinking and abominable, that it doth correſpond with the Ordure of Animals: The Truth is, that there be Places in the Earth that inſtantly kill, with a peſtilential Smell. And ſetting aſide the Stories of this Kind, both ancient and modern in remote Countries, I ſhall relate two Examples, where I myſelf was preſent, which was at the Diſcovery of the rich Country of *San Chriſtoval de los Lipes*; at that Time in a beautiful high Hill, that together with others encompaſſes the Dwelling of the Miners, two *Galleguares* found a Mine, which at firſt they called after their own Names, but ever ſince, to this preſent, it is called, from it's Effects, *The ſtinking Mine*. At firſt they got out of it very rich Oar (*Tacana*) between white Chalk: And as they began to ſink deeper, they were forced to give over, by reaſon of a moſt abominable ill Smell they met withal, which killed ſeveral of the Miners. *Indians*; and ſo it lay unwrought for four or five Years: After which Time another Miner (I being then in the Country) undertook to proceed in the working of it; thinking that having lain ſtill ſo long after it's firſt Opening, the ill Quality would have been evaporated; but that Experiment coſt the Lives of two *Indians* more, whereupon they forbore the Work, and have done ſo unto this Day. The which I have not ſo much wondered at, as to ſee with my Eyes the Ground opened in ſeveral other Parts of that Mountain, at a great Diſtance from the forementioned Mine, and in digging ſcarce a Yard deep, ſuch a Stink came out of the Ground as forced the Labourers to give over: And as I paſſed by thoſe Pits a few Days after, I ſaw divers Birds and Serpents dead in them, having been intoxicated by that poiſonous Smell: On the other ſide of this forbidden Hill (until Divine Providence make way for the Mining of the ſame) are built Dwelling-houſes, and a Mill to grind Metals withal, adjoining unto a marſhy Ground; which in every Place where they digg'd to lay the ſhallow Foundations of thoſe Buildings, the ſame Smell breaks out, as hath been already deſcribed; and it comes out of the Ground boiling like unto a Cellar full of Wine on the Muſt; exceeding troubleſome and noiſome unto us, though we were ſtanding by in the open Air.

In the famous Country of Mines, *Verenguela de Pacages*, in which the *Indians* procured a Patent to dig, before that of *Potoſi* was in uſe, becauſe it's Veins were eſteemed much richer than *Potoſi*, and upon Trial were found to be ſo; and the Oar gotten there inferior to none in the *Indies*. In the Hill of that Country called *Sancta Juanna*, a Miner followed a very rich and plentiful Vein of Silver, and intending to diſcover more of the like, he determined to break a Hole into an old Vault *, and ſet two *Indians* upon the Work, who after a few Blows diſcovered a Vacuity, out of which came ſo peſtilential a Stink, that killed the two *Indians* preſently, and almoſt ſtifled others that were at a Diſtance from them in the Mine, who nevertheleſs ran out, and told their Maſter what had happened. He made haſte to the Mine, hoping to ſave the *Indians*, but at firſt Entrance into the Ground, upon the Stairs by which they went down into the Mine, he fell down dead, and his Body remained there, no Body daring to go down and take it away to bury it,

---

* An uſual Practice among the Miners in that Country.

In another Mine in the ſame Mountain, in the Bottom of it, I ſaw a thick Exhalation or poiſonous Vapour guſh forth, making a terrible Noiſe, and was of Quality bad enough to kill one that would ſtay long in that Mine, putting out the Candles when we held them to it, which is a certain Sign of the Malignity of the Air, as hath been found by the conſtant Experience of all Miners, and therefore deſerves to be the more taken notice of.

CHAP. III.

How to know the Condition of the Earth by the Taſte.

THE Artiſt in the Knowledge of Metals, before he gives his Judgment, leaves no Experiment untried, that may be conſiderable for his Information.. And therefore uſeth his Taſte, which diſcovers the Pureneſs of Metals, as well as Smelling doth.

Pure Earth hath no manner of Taſte; and that Earth which is mixed with Minerals commonly hath a bad Taſte; becauſe ſcarce any Mineral but is aduſt, and they be all dry; whereas the very firſt Principle of Sweetneſs or good Taſte is Humidity.

Now ſince the Earth which hath ſuch a Mixture in it, is greatly diſpoſed alſo to contain Metals of like Condition, the curious Miner ought to make Trial by Taſting; holding it for a certain Truth, that Metals of Gold and Silver, and others, are found as often in the Form of Earth (which in the *Spaniſh* Miner's Language is called *Lampos*) as in Stones or Oar.

The Taſte of the Earth is gotten well by infuſing it in curious Water, eſpecially if you ſet it upon the Fire, and let it boil once or twice, and then cool again, whereby may be diſcerned the Mixture or Juice which it contains: And one that would improve this Experiment, may ſeparate the Water from the Infuſion, ſubſtantially and viſibly; as ſhall be ſhewn in it's Place, when we come to treat of the Preparation of Metals, to make them beneficial.

CHAP. IV.

Of the Names and Uſes of ſome Sorts of Earth.

IN the Books of Phyſic ſome Kinds of Earth are very famous for the Effects which they have upon Man's Body; and it is not unneceſſary that the Miner hath the Knowledge to diſtinguiſh them when they come in his way,

1. *Lemnian* Earth (ſo called from the Iſland *Lemnos*, where it is found) is very red, and much like unto red Oaker or red Lead, but it hath this notable Difference, that it will not colour ones Fingers in touching it, as do the others. It is eſteemed as rich as Gold, and ſold ſo Weight for Weight: One Cauſe of the Dearneſs of it is the Scarcity of it in the World; and another is, becauſe they dig it only on one Day in the Year, being ſuperſtitiouſly perſuaded, that Earth of this Kind only hath Virtue in it that is dug upon the $\frac{6}{16}$ of *Auguſt*. It is a rare Antidote againſt any Kind of Poiſon or Peſtilence.

2. That Earth which is commonly called *Bole Armeniac*, (from the vulgar Opinion, that it is found only in *Armenia*) is very like the *Lemnian* Earth aforeſaid, only it is not red, but paleiſh, white, or ſallow-coloured. There is excellent good of it, and in great

Plenty in the *Weſt-Indian* Mines, and particularly in the rich Mountain of *Potoſi*, and in thoſe of *Oruro*. Divers are of Opinion, that this common *Bole* is that which *Dioſcorides* calls *la Rubrica Synopica*: And that the Oriental *Bole Armeniac* is the true *Lemnian* Earth.

3. There be two Sorts of *Eritrian* Earth; one pure white, the other of an Aſh-colour; and this laſt is the better, and is known by rubbing it upon poliſhed Copper, where it will leave a Tincture of Violet Colour. It hath Virtue to ſtanch Blood, and to cool and heal green Wounds.

4. The Earth of *Samia* is light white Earth, and will ſtick to one's Tongue, if you touch it with it.

It is brittle, and yet will melt.

There is another Sort of it called *Aſter*, that is cloſe and hard as a Stone.

Both of them have the *Eritrian* Virtue in them; *viz.* to be excellent Antidotes againſt Poiſon, or the biting of Serpents.

5. The Earth called *Chia* is white, inclining to Aſh-colour, much like that of *Samia*, and hath the ſame Virtues; and over and above that, it takes Wrinkles out of the Face, and gives a good Complexion.

6. *Selinuſian* Earth hath the ſame Quality as the laſt aforementioned. The beſt Kind of it is that which gliſters much, is white and brittle, and ſooneſt diſſolves in Water.

7. *Cimolian* Earth is white, although there be a Sort of it that inclines unto Purple. The beſt is that which is moſt greaſy, and is very cold in one's Hand.

It diſſolves Impoſthumes, and little Swellings, and in Caſe of a Burn it will keep the Fleſh from bliſtering.

8. The *Pnigite* is almoſt of the ſame Colour as the *Eritrian*, but is found in bigger Lumps: It cools and refreſhes the Hand that touches it, and if one lick it, it will ſtick much unto the Tongue. It's Virtues are thoſe of *Cimolian* Earth.

9. The *Melian* Earth is of an Aſh-Colour like *Eritrian*; but it feels rough, and makes a Noiſe between the Fingers like a *Pomice-ſtone*: It has the Virtue of *Allum*, but very weak, as one may perceive by the Taſte, for it will make the Tongue ſomething dry: It cleanſes the Body, gives a good Complexion, and will cure the Itch.

10. Of that Earth which is called *Ampelites*, the blackeſt is the beſt. Ground with Oil it eaſily diſſolves, and hath a cooling and looſening Virtue: Alſo it is uſed to colour Hair withal; it is wholly bituminous as Jett is alſo.

Cardanus among his Curioſities makes mention of another Kind of Earth, anciently called *Britanica*, from the Country where it is found; they were fain to dig very deep Mines to come at it. It was white, and after they had ſeparated the Plate it contained, they manured their Tilth-fields with the Earth, which were put in heart thereby for 100 Years after.

11. Out of Iſlands in the South-Sea, not far from the City of *Arica*, they fetch Earth that does the ſame Effect as the laſt aforementioned. It is called *Guano*, (*i. e.* Dung)

not becauſe it is the Dung of Sea-fowls, as many would have it underſtood, but becauſe of it's admirable Virtue in making ploughed Ground fertile. It is light and ſpungy; and that which is brought from the Iſland of *Iqueyque* is of a dark grey Colour, like unto Tobacco ground ſmall. Although from other Iſlands nearer *Arica*, they get a white Earth inclining to a ſallow, of the ſame Virtue. It inſtantly colours Water whereinto it is put, as if it were the beſt Lye, and ſmells very ſtrong. The Qualities and Virtues of this, and of many other Simples of the new World, are a large Field for ingenious Perſons to diſcourſe philoſophically upon, when they ſhall bend their Minds more to the ſearching out of Truth than Riches.

CHAP. V.

Of Juices; and firſt of Allum.

THE Compoſitions within the Bowels of the Earth are ſuch as either will melt, or will not melt.

Thoſe that will not melt are hard, and called Stones; or being ſoft and eaſily crumbling into very ſmall Parts, are called Earth.

Thoſe that will melt, are either ſuch as after they run, by the Force of the Fire, become ſolid and malleable; and thoſe are Metals; or elſe ſuch as do not obtain thoſe Qualities,

lities, and thoſe are they that are called Juices.

From the Mixture of the aforeſaid four Kinds of Compoſitions are made eleven other Sorts of Minerals, and no more.

Thoſe which are hardened by cold, ungive again by Heat, as Sulphur; but ſuch as are condenſed by Heat are diſſolved again by Cold, and Water, *viz.* Allum, Copperas, Salt, *&c.*

1. Thoſe that write of ſimple Medicaments ſpeak of divers Sorts of Allum; but the true Allum is that which is called Rock-Allum, whereof ſome is white and tranſparent as Glaſs, and other ſome inclining to a red; and this hath the beſt Virtue, and is mightily reſtringent; and therefore called by the *Greeks Eſtypteria.*

According to the Opinion of *Galen*; *lib.* iv. *Of the Quality of Simples*, it ſhould be of a cold Quality, becauſe all aſtringent Things are ſo, and preſcribes therefore *Rupeciſſa*, as cold in the ſecond Degree, to be infuſed in the Quinteſſence of *Raymundus.* But *Dioſcorides*, and many others, make it to be of a hot Quality by it's Effects; but this is not a convenient Place to examine the Reaſons of it.

2. The *Allum* which is called *Eſcayola*, is not a Juice, but the ſame with the Earth of *Samia*, which the Ancients called *Aſter*.

3. Neither is the *Allum ſciſſile*, or *de pluma*, a Juice, which is yet taken for ſuch in Apothecaries Shops, but is the Stone called *Amianto*; and it is not aſtringent to taſte, nor conſumes in the Fire, although it be kept there

very long, which are the particular Qualities of an *Amianto*.

4. The *Allum Cutino* is made of the Aſhes of the Herb *Anthide* or *Soſa*, (*Barilla*, or the Herb they make Glaſs of) whereof there is great Abundance in the Plains of *Oruro*, and in ſeveral Places of the River *Langa-Sollo*.

5. The Salt which is made of the Lees of Wine, or of the Calcinings of the Lees until they become white, is likewiſe called *Allum*.

The *Weſt-Indies* abound in *Allum*, as they do alſo in all Sorts of Minerals. In the Mines of the *Lipes*, near unto *Colcha*, the head Town of that Country, I found a Vein of *Allum*: I have ſeen another in the hot Baths of *Ventilla*, in the High-way between *Oruro* and *Chayante*; and there I ſaw the true *ſciſſile Allum*, (or *de pluma*) with all the Qualities deſcribed by *Dioſcorides*. This ſame Sort of *Allum* alſo is brought to *Potoſi*, from another Mine near to *Perco Ayla*: And in many other Parts there is of the ſame; and there might of it be made in the City of *Potoſi*, if they would but boil the Waters *de la Quebrada*, or *Guayco de Santjago*, which are almoſt all *Allum*.

CHAP. VI.

Of Copperas.

THE *Copperas* is a Mineral Subſtance very like unto *Allum*, and oftentimes they are found incorporated together.

The Manner of ſeparating them, is to put the Lye that is drawn off from the Stone or Earth, which contains the Mineral, into boiling Urine, and the Copperas will divide from the Allum, and fall to the Bottom, the Allum remaining ſwimming on the Top. The Copperas is ſharp and biting to the Taſte, and of an aſtringent Quality; for which Reaſon divers do attribute unto it the Properties of Sulphur, Iron, and Copper, the Virtue of Allum, the Subtleneſs of Saltpeter, and the Dryneſs of Salt.

Some Alchymiſts have written as if the hidden Virtues of the Philoſopher's Stone were contained in this Mineral, whoſe *Latin* Name is *Vitriolum*; and they form a Saying to that Purpoſe, beginning every Word with one of the Letters of it, *viz.* *Viſitabis Interiora Terræ, Rectificando, Invenies Lapidem Veram Medicinam. Raymundus* ſaith, that it is very near of Kindred to Gold, and hath the ſame Original and Principle; and it may be that is the Reaſon why ſome affirm, that it is a Sign of a Mine of Gold, although the Experience in theſe Provinces doth not correſpond therewith. It is ordinarily found with Copper, and in great Abundance with the black Metal, which alſo participates much of it, and thence takes the ill Smell it hath in working.

It is a very fine Sort of Copperas, which the *Spaniards* call *Copaquiras*; and the beſt and pureſt of all, is that they call *Piedra Lipas*, from the Mine of it found in that Province; although a few Years ago a very plentiful Mine of it hath been diſcovered in the Province of *Acatama*, which is of a greeniſh Colour, and that of *Lipa* is blew. There is alſo whitiſh and yellow Copperas, which the Painters uſe; and different Colours of it have cauſed ſeveral Names to be given it: Of this Mineral are thoſe the *Spaniards* call *Myſi Sori Calobitis*, and *Melanteria*.

There is diſpute enough about it's Temperament and Qualities, as well as about that of Allum; ſome not allowing it to be hot in the third Degree, will yet allow it to be ſo in the fourth: And others on the contrary, are of the Opinion of *Juan de Rupeciſſa*, (who I think follows *Raymundus*) that it is cold in the third Degree.

It is admirable to ſee it's Effect in *Aqua fortis*, (in which all Metals, like Salt, diſſolve and are turned into Water) and an ocular Demonſtration of the Poſſibility of the Tranſmutation of Metals one into another: For with Copperas diſſolved in *Aqua Fortis*, without any other Artifice, Iron, Lead and Tin become fine Copper: And Silver will loſe of it's Value, and be turned into Copper alſo with a little Help of another Metal, very eaſy to be gotten.

By the Force of a moſt violent Heat they extract Oil from the Copperas, which is called Vitriol, of wonderful Virtue.

They make two Sorts of artificial Copperas, blew and green, of a Mixture of Iron, Copper, and Brimſtone, put in the Fire together.

Hereafter ſhall be declared, how and what Miſchief Copperas hath cauſed in the working of Metals, a Thing hitherto not taken notice of.

CHAP. VII.

Of Salt.

SALT is no leſs neceſſary than commonly known in the World: And that which is Mineral hath the ſame Virtue as that which is made of the Sea-water, or of the Waters of brackiſh Lakes or Springs. The only Difference is, that the Mineral Salt is more thick and ſolid, whence it comes to paſs to be more aſtringent, and not ſo eaſily diſſolved in Water as the made Salt is.

The Provinces of the *Weſt-Indies* as much abound in Salt as they do in Metals; and a Piece of the Sea between the *Lipes* coagulated into Chriſtalline Salt; as alſo the Salt-pits called *Garci Mendoza*, are none of the moſt inconſiderable Wonders of this new World.

Thoſe Pits are called *Garci Mendoza*, for their Bigneſs, becauſe they be forty Leagues long, and (where narroweſt) ſixteen broad: And alſo becauſe that ſometimes in the Middle of that Space are diſcovered, as it were, Wells that have no Bottom, and great overgrown Fiſhes are ſeen in them. It is very dangerous travelling over this Space of Ground, for Fear of loſing one's Eye-ſight, becauſe the great Gliſtering of the Sun-beams, upon that Place of Chryſtal, puts out one's Eyes, unleſs they be defended with black Tiffany. There is danger of Life alſo in that Journey; it having happened, that going over that Place, the Traveller and his Horſe, and all have been ſwallowed up, leaving no Manner of Mark behind either of them.

In the *Lipes*, four Leagues from the Mines of St *Chriſtopher de Achocolla*, there is a ſmall Lake upon the Top of a little Hill, in a Country they call *Tumaquiſa*; in the middle of which Lake the Water boils, and leaps up, ſometimes more, ſometimes leſs; making a frightful Noiſe. Out of Curioſity I went to ſee it, and found the Noiſe and Motion of it ſo terrible, that with Reaſon there be very few that dare come near the Mouth thereof. The Water is thick to that Degree, that it looks more like Dirt than Water: There is one ſmall Gutter where it runs over, and that Water iſſued forth, becomes red Salt, as it runs along in little Channels. This is a mighty ſtrong Salt, and has twice the Virtue of common Salt in the working of Metals.

It hath alſo been found to be an excellent Remedy for the Dyſentery; perchance it hath in it a Mixture of the red Allum, that gives it both Colour and Spirit. Hard by this Lake runs a Vein of *Piedra Judaica*; and the Country thereabouts is full of Mines of Copper.

A League and a half from *Julloma*, in the Province of *Pacages*, there be many Salt Springs, that as they guſh out of the Ground in a ſhort Time become pure white Salt, without the Help of any Art, and they increaſe into Heaps of Salt, until the Winter Rains diſſolve and ſweep them away. In the ſame Province near unto *Caquingora*, there be more Salt-pits like unto the former; and the like there is in ſeveral other Places. In theſe Parts alſo is found in great Abundance of the Mine or Rock-Salt, which is maſſy and tranſparent; looking like the pureſt Chryſtal. *Julloma* hath in it plentiful Veins of this Kind of Salt. Many Years ago the Inhabitants of *Curaguara de Carangas* have enriched themſelves by digging of Rock-Salt; and of later Years they have diſcovered Veins of it near the River of *Langa Collo*; but the Salt-Mines of *Yocalla* which God hath created near unto the rich Mountain and City of *Potoſi*, that nothing might be wanting that was neceſſary for the working of it's Oar, yields ſuch Abundance of Salt as is incredible; whereof is daily ſpent in the melting of Metals at the leaſt 1500 Quintales, and this Conſumption hath laſted for many Years.

Beſides the common Virtues of Salt, which every Body knows, *Arnaldo de Villa nova* in his Treatiſe for the preſerving of Youthfulneſs, ſays, that Rock-Salt is beyond any thing in the World for that Purpoſe: He calls it the Mineral *Elixir*, and preſcribes, that it be prepared with Things that do not weaken it, or alter it's Properties; but he does not name the Ingredients, nor the Manner of doing it. *Juan Beguino*, in his *Tyrocinio Chymico* teaches how to extract Oil out of it of an extraordinary great Virtue; and he ſays, that whatſoever is preſerved in that Liquor ſhall be kept from Putrefaction for many Ages: And he believes that this was it that preſerved the Body of the beautiful Maid, which *Rafael Volaterano* ſpeaks of, that was found in the Time of Pope *Alexander* VI. in an ancient Tomb, ſo freſh, as if ſhe had but juſt newly died, whereas it appeared by the Epitaph, that ſhe had been buried there 1500 Years before.

CHAP. VIII.

Of Salt Ammoniac, and other Salts.

AMONG all the Salts that Nature alone produceth, the ſcarceſt, but of greateſt Virtue, is the Salt-Ammoniac; they call it vulgarly Armoniac, and from that Name conclude, that it comes from *Armenia*, but that is not the true Name of it, but Ammoniac, which in *Greek* ſignifies, Salt of the Sand; and underneath the Sand (of the Sea-ſhore, I ſuppoſe) it is found congealed in little Pieces by it's internal Heat, and the continual burning of the Sun, baked ſo much, that it is made the bittereſt to taſte of all Kind of Salt. Goldſmiths uſe it more than the Phyſicians. It is one of thoſe they call the four Spirits, becauſe the Fire will convert them into Smoak, and ſo they fly away: The other three are,

1. Quickſilver,
2. Sulphur,
3. Saltpeter.

It hath a particular Property to cleanſe and colour Gold, and is put into the Compoſition of that *Aqua fortis* that diſſolves it.

At this Day we have little Knowledge of the true Nitre, which was anciently made of the Water of the River *Nilus*; although *Albertus Magnus* ſaith, that in *Goſelaria* there was a Mountain that contained a very rich Mine of Copper; and the Water that iſſued out at the Bottom of it, being dried, became Nitre. We know little alſo of *Aphonitro*, which is but as it were the Froth of Nitre.

Borax (which is called by the *Spaniards Chryſolica* and *Atincar*) is an artificial Sort of Nitre, made of Urines ſtirred together in the Heat of the Sun, in a copper Pan, with a Ladle of the ſame, until it thicken and coagulate, although others make it of Salt-Ammoniac and Allum.

Nitre is bitterer than Salt, but leſs Salt. Saltpeter is the mean between them two, and conſiſts of very dry and ſubtile Parts, it grows in the Walls of old Houſes, and in

Stables, Cow-houſes, Hog-ſties, and Dove-coats: It will grow again in the ſame Earth it was taken out of, if that Earth be thrown in Heaps and ſpared, and taken care of; or if ordinary Earth be caſt up into Heaps, and watered with brackiſh Water, after ſome Years it will give a great Encreaſe, as profitable as Crops of Grain.

The Uſe of it in making of Gunpowder and *Aqua fortis* is very well known. It is uſed alſo in the melting of Metals, as ſhall be ſhewn hereafter.

CHAP. IX.

Of *Juices, which the* Spaniards *call Betunes.*

THE Betune is one of the Things that does moſt Damage of all unto Metals, eſpecially in the melting of them, becauſe it burns them, and makes them become Droſs, if they be not cleared of the Betune before they be put into a fierce Fire: There be twelve Sorts of Betune, *viz.*

Aſphalta,
Biſſaſphalta,
Naptal la Piedra,
Gagete,
Azabache,
Ampelites,
Maltha,
Piedra Thracia,
Carbones de Mina,
Ambar de Cuentas,
Ambar Oloroſa,
Alcanfor.

But few of theſe Sorts are found mixed with Metals.

All Betunes are the Oilineſs or Fat of the Earth; and although ſome are of opinion, that *Alchamphor* is the Weeping or Gum of the Tree *Capar*, in the Iſland of *Zebat*, and the Amber of another Herb called *Poleo*, in *Spaniſh*, whereunto it is commonly found ſticking. And to the ſmelling Amber they aſcribe for it's Original a great Fiſh in the Sea like a Whale, becauſe there is great Reſemblance between it and *ſperma Ceti*. Nevertheleſs that doth nor hinder, that ſuch Subſtances alſo may, like Sweat as it were, iſſue forth of the Earth, and make theſe Juices called Betunes.

Aſphalto is found in the Lake of *Sodom*, or the *Dead-Sea*, in *Judea*, into which runneth the River *Jordan*, three Leagues from the City of *Jericho*. It is nothing elſe but an oily Froth that ſwims on the Surface of the Water of that Lake, agitated and driven by the Winds and Waves a-ſhore, and there condenſes and hardens. It is like unto Pitch, but harder, and of a better Colour. Before God overthrew thoſe wicked Cities of *Sodom*, *Gomorrha*, *Admah*, and *Sebcim*, that fertile Valley had little of this Betune in it, as may be collected from *Gen.* xix.

Theſe are found alſo in many other Places and Provinces, ſome whereof uſe them to make Candles with, inſtead of Oil; although in *Peru* they have not been curious in farther Search than how beſt to work their Oar of Gold and Silver, yet by the Plenty of them that the *Indians* bring, it is known that there are of them in the *Cordillera de la Chiriguanes*, in the Frontiers of *Lomnia*, although they have little Acceſs to them, becauſe they be in the Power of the *Indians* that maintain War againſt the *Spaniards*.

The *Piſſaſphalto* is a natural Compoſition of *Aſphalto* and *Paz*, and ſo the Colour of it declares; and for want of the true natural *Piſſaſphalto*, they counterfeit it of thoſe two Materials.

La Napthe is a ſulphurous Liquor, ſometimes white, and ſometimes black alſo, and is that which is called Oil of *Peter*, of admirable Virtue to cure old Pains, proceeding from cold Cauſes. It will draw Fire to it, as the Loadſtone does Iron, with that Force, that it will take fire at a great Diſtance from the Flame, as hath been confirmed by the miſerable Experience of the *Conde de Hercules de Icontrarii*, of the Country of *Ferrara*, who having a Well in his Ground, the Water whereof was mixed with *Petreol*, and by ſome Breaches or Cracks in the Well much of this Water ran to waſte, commanded it to be repaired; the Labourer that was let down into the Bottom of the Well deſired a Candle, the better to ſee his Work, which was furniſhed him in a Lanthorn; and immediately through the Hole of the Lanthorn the *Napthe* ſucked the Flame into itſelf, and ſet Fire on the whole Well, which diſcharged itſelf inſtantly like a great Piece of Cannon, and blew the poor Man into Pieces, and took off an Arm of a Tree that hung over the Well. The *Conde* himſelf told the Story to *Matiolo*, who reports it in his *Dioſcorides*.

Aſphalto and *Piſſaſphalto* melt in the Fire as Pitch or Wax, and by that they are diſtinguiſhed from the *Piedra Gagate*, or *Aſcabache*, and alſo from Pit-Coal, which burns and conſumes it ſelf away like Tea, or any other ſort of Wood. As yet I have not heard whether there be any Betunes in theſe Provinces, although I perſwade myſelf there be, if they were ſought for.

CHAP. V.

Of Sulphur and Antimony.

SUlphur is a Mineral the moſt univerſally known of any. It is made of an earthy unctuous Subſtance, and very hot, to that degree, that it is eſteemed to be neareſt of kin to the Element of Fire of any compounded Subſtance. The Chymiſts call it the Maſculine Seed, and Nature's firſt Agent in all Generation: And they ſay, that the difference between one thing and another, ariſes from the divers Preparations and Mixtures of Sulphur and Quickſilver. It hath happened to an Apothecary, that going about to make a Salve compounded of thoſe two Materials; he has found the reſult to be a Plate of fine Silver. After many Conſiderations of this Subſtance, *Theophraſtus Paracelſus* proceeds to contemplate the Wonders produced by Sulphur, and ſaith, that God by an eſpecial Providence hath concealed thoſe Myſteries; and that it is an evident Confutation of thoſe, who oppoſe the Tranſmutation of Metals; for this Mineral doth effect it: And he teaches a way to make an Oyl, called in *Spaniſh* (*Epatica Sulphuris*) which turns Silver into Gold. And *Heliana*, the Author of a Book called *La Diſquiſition*, teaches the ſame thing with raw Sulphur, to ſhew the poſſibility of it, although it be in very little Quantity. The Smoke of it helps to fix the Quickſilver, and turn it into Plate, whereof there be many Eye-witneſſes in theſe Provinces. And this Sulphur diſtilled in a Glaſs-ſtill, makes the Oyl of Sulphur of ſuch rare and admirable Virtue, eſpecially for the *French* Pox, taking three or four Drops thereof every Morning for a Week together in ſome Liquor proper to convey it in. It is good to cure the difficulty of Urine, and the Pains of the Gout, and many other things, as you may ſee in *Diodorus Euchiente*, and divers other Authors. There is abundance of Brimſtone in the Province of the *Lipes*, and in the Confines of the *Pacages*, and in *la Puna de Tacora*, or *los Altos de Arica*, and in many other Parts beſides; it is found incorporated with Metals in the richeſt Mines of *Peru*.

The Antimony, or *Stibium*, which ſome Miners call by the Name of *Alcahole*, and others (particularly in *Oruro*) call it *Macacote*, is a Mineral very like unto that they call *Sorocha*, or Lead, that is very porous; it ſhines very much, and is brittle; ſome of it is of a reddiſh yellow Colour, and ſome there is more inclining to white, and very finely grained, as Steel ſhews where it is broken.

It is made of a very corrupt, and imperfect Mixture of Brimſtone and Quickſilver, and

ſeem

ſeems to be an Abortion of Nature, and the ~~*Embrio*, which would become Metal, if it~~ was not taken out before it's Time.

Porta Vegino, and others do teach a way to draw out of this a kind of Quickſilver, which they call *Regalo*; but it is inclining to red, and has not ſo lively a Motion as the ordinary Quickſilver. By *Aqua fortis* alſo Brimſtone (whereof it is compounded) is gotten from it in it's proper Form, of a green Colour, and burns as ordinary Brimſtone does.

Baſilius Valentinus in his Triumphal Chariot of Antimony, having ſpoken of many of it's Excellencies, afterwards teaches how to make of it a Fire-ſtone (as he calls it) which will turn other Metals into Gold. *Paracelſus* writes much alſo to the ſame Effect; and other Chymiſts with a continued Voice do ſpeak of an Oyl which is gotten from Antimony for the ſame purpoſe: But from a more certain and neceſſary Experience does *Matiolus* commend his Ointment, for the curing of old Ulcers, and for other Medicinal Uſes.

Stibium has a drying and aſtringent Virtue, and the Preparation (which they call) *Hiacint* is held to be a very ſtrong Purge, and a Provoker to Vomit. This *Alcabol* is very commonly found comprehended in the Silver Oar, and particularly in that which in *Peru* is called the black Oar; nevertheleſs in many Parts it is found in a Body by itſelf. It does a great deal of miſchief in the working of Metals, as the Beturie and Brimſtone does, and therefore muſt carefully be gotten out before-hand, as ſhall be ſhewed hereafter.

CHAP. X.

Of *Marcaſita*, *Orpiment*, and *Sandaraca*.

MArcaſita is alſo called *Syrites*, which ſignify a Stone of Fire, becauſe being ſtruck with Steel, it yeildeth Fire in greater abundance than any other Mineral: Some will have it to be begotten of an undigeſted Vapour, others that it is compoſed of a courſer Sort of Brimſtone, or Betune, and Stone; it grows in all ſorts of Mines, but eſpecially where there is Copper, and the black Silver Oar, whereof it doth much participate, and perhaps that is the Reaſon why *Dioſcorides* ſaith, that the *Marcaſita* is a kind of Copper: and notwithſtanding *Albertus* and others do think the *Marcaſita* contains no Metal in it, yet Experience has taught the contrary; for the Farmers of the Mines of *Monſerrat en los Chichas*, when they begun to dig thoſe Veins, they found the Oar to contain as much Silver as it did of *Marcaſita*: And in this Mountain of *Potoſi*, and others, there is a fine ſort of this *Marcaſita*, which is found incorporated with the black Silver Oar, and is a certain Sign of it's Richneſs; there be as many kinds of *Marcaſitas*, as there are of Metals, whoſe Colour they repreſent; the moſt common ſort looks like Gold; being put in the Fire, it ſmells like Brimſtone, and flames much, which is a

Sign it is compounded, as has been ſaid before.

Gold, Silver, and Copper are uſually found contain'd in it: It is a great Hindrance to the melting of that Oar, where it is incorporated, dividing the Quickſilver into very ſmall Particles, as ſhall be ſhew'd hereafter, together with the proper Remedies for it.

Orpiment and *Sandaraca* are of the ſame Nature and Virtue, and are only made to differ by their greater or leſſer Concoction in the Bowels of the Earth. *Sandaraca* being nothing elſe but *Orpiment* well concocted, and by Conſequence thereof, highten'd in Virtue, as is demonſtrated by putting *Orpiment* into a Fining-pot, and ſetting it on the Fire, whereby after a convenient Concoction, it will become red, and of as lively a Colour as the moſt perfect natural *Sandaraca*. Where *Orpiment* is found, it is a certain Sign of a Mine of Gold, whereof alſo it always contains ſome Seed or little Particle; as *Pliny* reports, in the time of the Emperor *Caligula*, that he did then extract ſome Gold out of it: ſince that time it has not been attempted, becauſe the Coſt does much exceed the Benefit.

The beſt ſort of *Orpiment* is that, which is of a ſhining Gold Colour, that is not faſt compacted, and eaſily breaks into Scales. The moſt perfect *Sandaraca* is that, which is reddeſt, pureſt, and the moſt brittle, of the Colour of *Cinabrio*, (an *Indian* Word, of a Gold Colour) and it hath a ſtrong Smell of Sulphur, whereby, as alſo by it's other Qualities and medicinal Virtues, it is diſtinguiſh'd from *Sandix*, which is of the ſame

Colour, and is made of *Albayalde* well burnt in the Fire, which ſome alſo improperly call *Sandaraca*; theſe are Poiſon, by reaſon of their ſtrong, corroding, and burning Quality, not only upon the Bodies of Animals, but upon Metals alſo, in like manner as Antimony, or Brimſtone, or other dry Minerals; for by Reaſon of their oily parts, they take Fire, and being mingled with Metal, they burn and conſume the Moiſture thereof whereby the Metal moulders away, and is loſt: There be other Juices that are ſcarcer, and not commonly known, as they report of one that is found in the Mine of *Ancbergo*, which is white and hard, and poiſons the Cattle that taſte it: And it may be, of this kind was that Vein, which Perſons of good Credit have told me was found in the Province of *Conchucos*, in the Archbiſhopric of *Lyma*, with which the Inhabitants of that Country uſed to kill thoſe they had a mind to be rid of; to prevent which wicked Practice, the holy Archbiſhop *de los Reyes*, *Don Soribio Alonſo de Magrobejo*, commanded the Mine to be ſtopt up.

CHAP. XII.

Of the Generation of Stones.

IT is moſt certain, that there is ſome very active Principle or Virtue that operates in the Generation of Stones, as well as upon the reſt of the Matter of the Univerſe, that is ſubject to Generation and Corruption; but the Difficulty lies in knowing what that Principle is, becauſe it operates in no determinate Place, but ſometimes Stones are made in the Air, in the Clouds, in the Earth, in the Water, and in the Bodies of Animals.

Avicenna and *Albertus* think the Matter whereof Stones are made, to be a mixture of Earth and Water; and if the greater part be Water, it hath the Name of Liquor; but if the greater part of it be Earth, then it is call'd Dirt or Clay.

That Clay which is fit to make Stones of, muſt be tough and ſlimy, ſuch as Bricks, Pots, and other earthen Veſſels are made of; for if it be not ſuch, as ſoon as the Fire hath conſum'd the Moiſture of the Dirt, it will not hang together, but crumble into Earth and Duſt: It is alſo neceſſary, that the Liquor which is to be converted into Stone be very ſlimy; the Experience whereof we find in our own Bodies. The Phyſicians being generally of an Opinion, that the Stone is begotten in the Reins and Bladder of ſlimy tough Humours, bak'd hard by the Heat of the Body; this Opinion touching petrifying Liquors, is confirm'd paſt all Queſtion, by the Experiment of that famous Water in this Kingdom of *Peru*, near unto *Guancaveilca*; which they take and put into Moulds of what Form and Bigneſs they pleaſe, and expoſe it to the Sun for a few Days, whereby it is made perfect Stone, and they build their Houſes with it: All the Cattel that drink it dye, and from what has been ſaid before, it is not hard to conjecture the Reaſon.

In a Mountain call'd *Pacocava*, a League from the Mines of *Verenguela de Pajages*, there be Springs of this Liquor, the Colour whereof is whitiſh, inclining to yellow, that as it runs along condenſes into very hard and weighty Stone of different Shapes. Moreover any porous Subſtance that can ſuck this kind of Liquor into it, is apt to be turn'd into Stone; and of thoſe I have ſeen Trees, and Limbs and Bones of Beaſts turn'd into hard Stone. In the City *de Plata* I have ſeen Sticks of Wood taken out of that great River of the ſame Name; ſo much of which as had remain'd cover'd with the Water, being converted into very fine Stone. I ſaw alſo the Teeth and Bones of Giants, that were dug up in *Tarija*, turn'd into heavy and hard Stone.

Stones have their ſubſtantial Forms, which makes them differ ſpecifically; yet, becauſe we cannot come to the Knowledge of them in our Definitions, we are fain, by way of Periphraſis, to make uſe of Accidents and Properties. Every ſeveral form of the Stones is accompany'd with particular Virtues, as remarkable as thoſe of Animals or Plants, and proportion'd to the length of Time Nature takes in it's Generation; but becauſe Plants and Animals are to have ſo different Diſpoſitions, and to produce ſuch various and admirable Effects, they cannot be of ſo uniform, and well mingl'd a Temperament as the Stones are, nor is their ſoft and gentle Subſtance capable to endure ſo much Force; as neither is the Hardneſs of the Stones fitted for the producing variety of ſeveral Shapes, and therefore in them are found no Leaves, Flowers, Fruits, Hands nor Feet, as in Plants and Animals, though they have a greater Virtue of another kind.

CHAP. XIII.

Of the Differences of Stones one from another.

ALL ſorts of Stones are reducible under ſome of theſe five following Species.

1. If they be ſmall, very ſcarce, and very hard of Subſtance, and have Luſtre, they are call'd precious Stones.

2. If they be of great Magnitute, altho' they be rare and have Luſtre, they are ſome kind of Marble.

3. If in breaking they fall into Splinters or Scales, they are a ſort of Flints.

4. If they be of a ſmall Grain, they be Pebbles.

5. Thoſe that have none of the abovesaid Qualifications, are Rocks or ordinary Stones.

But the Miners for the better Diſtinction of the ſorts of Stone wherein Metals are engendred, uſe peculiar Names for them; for example, a kind of Stone like Pebble, which contains Gold, Silver, or any other Metal they call *Guiios*, which breeds a richer Vein of Metal than any other Stone.

Cachi, another ſort of Stone, white like Alablaſter, ſoft and eaſy to break in pieces, is all this Country call'd Salt. Much Lead is engendred in this kind of Stone, in the Veins of *Metales pacos*, which is the Name the Miners here give unto their Silver Oar.

Chumpi, which is ſo call'd, becauſe it is of a grey Colour, is a Stone of the kind of Eſmeril, mix'd with Iron; it ſhines a little, and is very hard to work, becauſe it reſiſts the Fire much. It is found in *Potoſi* and *Chocaya* and other Places, with the black Metals and *Roſicleres*.

Lamacrudria is that Stone which is cloſe compacted, and ſolid, and ſhews not the leaſt Grain nor Porouſneſs when you break it, and is of a yellow Colour, and ſometimes high colour'd, as Blood-red.

Almaclaneta is the Name they give another kind of Stone, which is very ſolid and weighty, of a dark Colour, always found in the Company of rich Metals, which are engendred in it, when it comes to be corrupted and rotten; as in like Manner is done in the *Gouiños*. It grows upon the Flints of the Gold Mines, and thoſe of Copper and Silver.

Almolacleru, or Whetſtone, is that ordinary Stone, which is commonly made uſe of for that Purpoſe, and ſo known to every body. Divers rich Metals grow upon it, but moſt commonly *los Cobriſcos*.

The Veins of Silver are rare and inconſiderable that are found in Pit-Coal; altho' it be a more proper Bed for Gold.

Other Stones that grow in Mines, or cleave unto the Metal, they call *Ciques*, and alſo *Caxas*, which are rough and uneven, but not very hard, nor very ſpongy, and commonly have nothing of Metal in them, altho' in ſome rich Mines they are infected with ſome little, by the Vicinity of the Oar.

The Stones of *Potoſi*, call'd *Vilaciques*, have been, and are very famous for the Abundance of Silver gotten out of them; and are one of the Ingredients that make this Province without Compariſon. *Vila* ſignifies Blood in *Peru*, or any red thing; and for the Streakes of red this Stone hath in it, they call it *Vileciques*.

CHAP. XIV.

Of precious Stones.

PRECIOUS Stones are either tranſparent, as the Diamond is, or obſcure, as the Onix, or between both, as the Sandonyx and the Jaſper. It is the Water which is the principal Cauſe of Clearneſs, and the Earth of the Opacity of them. So that the Reaſon why they excel one the other in Luſtre and Tranſparency, is from the variety of Humours congeal'd together to compoſe them, which are ſome of them more pure and clear than others.

White Stones are made of Humour almoſt like Water, and ſo are more clear and tranſparent;

ſparent; ſuch is the Chriſtal, and the *Iris* ſo call'd, becauſe being held oppoſite to the Sun-beams, it much reſembles the Rainbow.

The Diamond is engendred of a leſs clear Humour, than the Chriſtal or Iris, and ſo is more obſcure than either of them. The ſame Variety may be obſerved in all precious Stones of what Colour ſoever they be; whether compoſed of Juices or Humours that be green, as the Emerald, and the Praſma; or of blew, as Saphir, the Cajano, and ſome ſort of Jaſper; or red, as the Ruby; or purple, as the Jacynth and Amathiſt; or Gold-colour, as the Chryſolites and Topaz; or of mingled Colours, as the Opalos.

In like manner it is to be imagin'd, that the other ſorts of Stones that are not tranſparent, are engendred of a Mixture of black and thick Humours; an Inſtance whereof we ſee in Water, which though it be naturally white and clear, yet mingled with Ink or ſuch like Liquor, it loſeth it's Tranſparency, tho' not the Luſtre of it's Superficies.

The different Colours of the Juices or Humours aforeſaid, ariſes from the various Mixture of black and white Matter, whereof the Stones are engendred. Although *Raymundus* and many others attribute it more immediately to the Variety of Metals, of whoſe pureſt Liquors precious Stones are engendred, in the Heart of other hard Stones, whither that Liquor hath penetrated, and thereby much refined itſelf. And that in Eſtimation, precious Stones hold in Proportion to the Metals of which they are engendred, as the Ruby to Gold, the Diamond to Silver, the Emerald to Copper, and the reſt in like Manner. In his *Compendium* of Tranſmutation, dedicated to *Robert* King of *England*, he doth particularly teach the Way of making artificial precious Stones, by a Mixture of the Waters of divers Metals, as beautiful and of the ſame Virtue as the natural ones are. A Knowledge over and above other excellent Qualities of that rare Perſon, which ſeems to out go Human Capacity. But it is the eaſier to be believed, becauſe we ſee Eſmalts made of divers Colours, by a Compoſition of Minerals ground to Powder and Glaſs, and falſe Stones made in the ſame Manner.

Tranſparent precious Stones have many Faults in them, which by Reaſon of their Clearneſs are ſooner diſcover'd by the Eye, than thoſe in common Stones, as Spots appear the moſt in fineſt Garments; and it is rare to find a Stone that hath not ſome Defect or other; either Spots, or Hair, Cloud, Shadow, Salt, or other thing ſubject to be engendred in them, becauſe the Humour of which it is made is not all of one Colour. A Shadow ariſes from the Humours being more obſcure in that Part. A Cloud comes from the Humours being too white in that Part. Hairs, which are ofteneſt found in the Saphir, and Salt which particularly hurts the Opalos, as Lead doth the Emerald, are Impediments of different Colours from the true Colours of the Stone in which they are.

CHAP. XV.

Whether there be precious Stones in the Kingdom of Peru.

HITHERTO the Induſtry of the People of theſe Provinces hath been principally apply'd in the ſearch after Gold and Silver, and they have neglected the Enquiry after precious Stones, altho' there have been and are many notable Indications that this flouriſhing Kingdom wants not this Prerogative alſo.

There is a conſtant Report, and I myſelf have heard it in the Country of the *Lipes*, that in the adjoining Province of *Acatama*, there have been found excellent Diamonds; and that in exchange for a little *Cocus*, worth not above two Reals, an *Indian* old Woman ſold a handful of rough Diamonds, which in *Spain* were worth many Ducats. It is a Country full of beautiful Stones to ſee to, and therefore may very well be ſuppoſed to have Riches in it.

There be ſtore of Amathiſts in a Wood call'd by that Name, which ſtands hard by the Mines of *Eſmeruco*. And in the rich Mine of St *Elizabeth* of new *Potoſi*, there be found rich and well grown Amathiſts among the Silver Oar. There are of the ſame kind of precious Stones in *Paraguay* and *Buenos Ayres*;

Ayres.; they are engendred in *Papas Lanadas*, one or two Fathom under Ground, in a very hard and heavy Flint-ſtone, which they call a *Coco*, becauſe like the Coco Nut; it is about the bigneſs of ones Head. The Amathiſt within will be as big about as two Fingers, naturally coagulated into Shapes like fine Lace, and is more or leſs mature and perfect, according to the Condition it was in when the Coco burſt, which it doth of his own Accord, and then makes a Report like a piece of Ordinance, and makes the Earth near it tremble for a good while; and that juſt over it to break and open; by which Tokens Men go to the Place, and dig for the Coco, which they find ſplit in two, three, or more Pieces. This is a thing well known, and common in theſe Parts of the World, Near unto the Place, call'd *Aqua Caliente*, for the hot Water that there guſhes out, in the Way between *Potoſi* and the *Lipes*, there is a *Pampa* full of a pure tranſparent Chryſtalline Stone, form'd by Nature into ſeveral Angles, that meet in one Point: I always pickt up ſome of them when I went that Way; admiring their Beauty, for expoſing them to the Sun-beams, they look'd all like ſo many ſeveral Suns. The largeſt that I ſaw of them was about the bigneſs of ones Thumb.

Of this ſort, altho' much ſmaller, yet there be abundance in the Countries of *Callapa* and *Jullcma*: In the Province of *Pacages* I gather'd ſome alſo naturally cut like Roſe-Diamonds, as big as large Peaſe; and waſhing the Sand, I often obſerv'd amongſt it little ſmall Points of the Colour of Gold, and tranſparant, parent, like unto the beſt Topaz; and others of that Sort as big as Barley-corns, which if they were bigger, would be of great Eſteem, and no doubt but ſuch might be found, if hearty Induſtry were employ'd thereabout.

The Stones of the Mine of *Camata*, in the Province of *Larecaxa*, do vie in Beauty with the Diamond, and are worn in Bracelets and Ring in this Kingdom.

In the great Head Land of *Arica*, between the Rocks within the Port, there is a Mine, whence they get Stones tranſparent as Diamonds, and very near as hard, whereof alſo they make Jewels.

The beſt Turqueyes are found in *Atacama*: I have ſeen one in the *Lipes*, as big as a twelvepence *Engliſh*. The *Indians* of this Country eſteem it great Bravery to have Necklaces and Bracelets of ſmall Turqueyes curiouſly compoſed. The Men wear great ones of this Kind about their Necks, like Gold Chains. They wear ſuch Chains alſo of green Stones; and the Officers of their Armies eſteem them moſt of all, and account them the beſt Ranſom a Priſoner can give them.

Pearls alſo are gotten on the Coaſts of *Atacama*, and in the *Mexillones*, which are taken out of Oyſters, and brought hither to ſell: it is very ordinary to find Pearls in the Dreſſing or Eating of Oyſters.

I have little Knowledge of the Fertility of the Lower Countries in theſe kinds, becauſe they have little or no Commerce here. Beſides my chief Intention is to give your Lordſhip Information of the Mines of the Provinces ſubject to your own Juriſdiction, and that I have ſeen in Perſon. Nevertheleſs, at the Time of the firſt Conqueſt of theſe Countries, there were found many and very large Emeralds in the Hands of the Natives, as appears by the Hiſtories thereof.

CHAP. XVI.

Of other ſorts of Stones.

IT doth very little import the Owners of Mines, for whoſe ſake principally, by your Lordſhip's Command, I have written this Treatiſe, to diſcourſe more particularly of other Stones, although the common ſort of Stones, becauſe they are ſo, are little inquir'd into or underſtood; and when in Mines they meet with ſome Stones of rare Colour and Tranſparency: Their Beauty would invite the Miners Eſteem, if the Covetouſneſs after Gold and Silver, which they ſeek for, did not blind their Eyes and Underſtandings, ſo that they cannot attend to look after them. But becauſe I have given an Account of all Minerals together; and that Marbles are of next Eſtimation unto precious Stones: It is but Juſtice to treat a little of thoſe Marbles we find in theſe Provinces, which I believe equal to any that we read of in Story.

The Province of *Acatama*, above all others, beſt deſerves to be curiouſly enquir'd into, by able and experienced Artiſts; for it produces

Stones of ſuch various Colours, and beautiful Gloſs and Luſtre, that only the great Quantity and Abundance of them hinders them from being reckon'd among the precious Stones.

This whole Kingdom is full of curious Altars made of theſe Stones, and many of them have been carry'd into *Europe*, and they have not been wrought for any other Purpoſes; yet either for want of Stone-cutters to work them, or becauſe moſt of us in theſe Parts have in our Eye to return home again into *Spain* with great Eſtates, and care not for perpetuating our Fame in theſe Parts by ſumptuous Buildings, for which theſe of ſort Stones were very fit Materials.

There is a Stone in this Imperiality, worthy for it's Variety, Luſtre, and Greatneſs, to be preſented to the View of the King our ſovereing Lord. It is ſix Palms in Length, and one Palm ſix Inches leſs in Breadth, and two Fingers thick; it is in form like a Plank or large Table; it is full of delicate Clouds, made by the Compoſition of it's Colours: There be ſome red, and ſhining tranſparently, others more obſcure, as black, yellow, green and white. Upon the blackeſt Spot in all the Stone is reſembled Snow, as it were falling upon it, or Milk, according as the White happens to be mix'd with Shadow.

In the Mines of *Verenguela de Pacagues*, there be other Stones, not inferior in the Nobleneſs of their Subſtance and Luſtre, to thoſe of *Atacama*, altho' they have not that Variety of Colours. They be white as Alablaſter, and tranſparent; and becauſe that Colour is not equally diſtributed, it cauſeth, as it were, Clouds, which gives much Graceſulneſs and Beauty to the Stone: No Liquor will ſink into them, they be ſo hard, like unto Chryſtal. The Font in the Church of *Julloma* is a very large one, and yet is made of one of theſe Stones; and tho' it be ſix Fingers in Thickneſs, yet you may plainly ſee thro' the Sides of it the Light of a Candle ſtuck up in the Middle. In the Jeſuits Colledge in the City of *Paz*, there is a famous Water-pot of this Stone, thro' whoſe Sides you may ſee the Water riſe as it is poured in, juſt as if it were thro' tranſparent Glaſs.

CHAP. XVII.

Of ſome Accidents happening to Stones, and the Cauſe of them.

BESIDES Shining and Tranſparency, which as hath been ſaid, is found in divers Stones, and in the common ſort of Stones is not found; there be alſo other Accidents that accompany them, *viz.* Hardneſs and Softneſs.

Hardneſs is ſo eſſential to all precious Stones, that they be not held for ſuch, upon whom the File will make any Impreſſion. If the Matter of which the Stone is compounded be tough, and dried by a violent Fire, till the Moiſture be conſum'd, it cauſeth Hardneſs, becauſe it contracts and condenſes the Matter within itſelf. If the Matter have little or no ghneſs, Toughneſs, then the Moiſture being eaſily dry'd away by Heat, and the earthy Part burnt, there will remain a Stone ſoft and brittle; alſo the ambient Cold will condenſe Matter and make it hard, as we ſee in Stones congeal'd thereby, the which will diſſolve again by the Fire, and the congeal'd Humour relax and run; Stones that want Moiſture enough to glue their terreſtrial Parts together, when they be put into the Fire they break into ſmall Pieces; and thoſe which are drieſt of all do reſolve into Duſt or Lime by the Fire.

Some Stones are porous, others maſſy, and well put together. The firſt ariſes from the unequal and ill Mixture of the wet and dry Parts whereof it is compounded, ſo that the Heat exhaling the Moiſture, where no earthty Subſtance was mingled with it, leaves a hollow Place or Pores, which make ſpongy Stones. As for the oppoſite Reaſon, we ſee the contrary Effect in maſſy Stones. Stones are found of various Figures, and cauſing as much Admiration as moſt Things in Nature. Perchance it may come from the various Mixture, Colours, and Veins of Stones, as you may ſee in their Clouds and Spots repreſented Towers, Sheep, and other Animals and Figures. And in Lead pour'd out upon Water often happens the like. The Story is famous of the Agates of King *Pirrhus*, that repreſented *Apollo* and the nine Muſes as lively as the beſt Painter could draw them; and *Cardanus* ſays, he had one of that kind that was a true and exact Picture of the Emperor *Galba*.

They ſay, that in the Houſe of *Wiſdom* at *Conſtantinople*, there is a Marble Stone, that by the very natural Veins of the Stone, hath the Picture of St *John* the *Baptiſt*, with his cloathing of Camels Skin expreſſed to the Life, excepting one of his Feet, which is imperfect.

It is a ſign that Nature hath not wrought by Chance, but by particular Study, and to ſome myſterious End, when in the ſame Species of Stones are found the ſame Marks and Figures, like thoſe in the Fields of *Verona*, which *Leon Baptiſta* reports to have ſeen; and that they have painted upon them the Image of the Chair of *Solomon*. And another black Stone, which being broken at one End, hath painted in it exactly, and to the Life the Picture of a Serpent; and that it hath the Virtue to draw Serpents unto it. *Albertus Magnus* affirms to have ſeen 500 Serpents gotten upon a Stone of that kind, which was preſented unto him.

When we meet with Stones that repreſent Animals, or the Limbs of them, or Plants, or other Things, not by ſuperficial Draught or Colouring, but in Bulk and Subſtance. I believe it may ariſe from ſome petrifying Liquor, which that Matter has ſuck'd into it's Pores, and thereby is become all Stone, and ſo thinks *Avicenna*: But although ſometimes this may be the Cauſe thereof yet methinks it cannot reaſonably be ſuppoſed to be ſo always.

At the Foot of the Mountains *Miſnenſes*, near unto the Lake of *Alſatia*, Stones are very commonly found that have emboſs'd upon their Superficies, the Images of Frogs and Fiſhes in fine Copper. Anciently they call'd a ſort of Stone *Conchites*, which were in all their Lineaments very like unto the Cockles of the Sea; and they thought that thoſe Fiſh-ſhells lying a long time in Soil, where much Stones were begotten, the petrifying Liquor entring into the Pores of the Shell, converted it into Stone: And they ground this Opinion upon the Certainty that the Sea in old Time hath overflown the whole Territory of the City of *Magara*, where only theſe ſort of Stones are found. But of latter Times all Colour of Reaſon is taken away from the foremention'd Conceit, by the wonderful Veins of Stone, ſome grey, ſome iron colour'd, and ſome yellow, which are found in the Highway as one goes from *Potoſi* to *Oroneſta* down the Hill. There they gather Stones that have in them Impreſſions of divers ſorts of Figures, ſo much to the Life, that nothing but the Author of Nature itſelf could poſſibly have produc'd ſuch a piece of Workmanſhip. I have ſome of theſe Stones by me in which you may ſee Cockles of all ſorts, great, middle-ſiz'd, and ſmall ones; ſome of them lying upwards, and ſome downwards, with the ſmalleſt Lineaments of thoſe Shells drawn in great Perfection; and this Place is in the Heart of the Country, and the moſt double mountainous Land therein, where it were Madneſs to imagine that ever the Sea had prevail'd, and left Cockles only in this one Part of it. There be alſo among theſe Stones the perfect Reſemblance of Toads and Butterflies, and ſtrange Figures, which tho' I have heard from credible Witneſſes, yet I forbear to mention, and not to overburden the Belief of the Reader. Over-againſt this wonderful Vein of Land, on the other Side of the Valley of *Oroncota*, ſtands that famous Piece of Land they call *Pucara*, which ſignifies in their Language Fortreſs, it is a Place the beſt fortify'd by Nature of any now known in the World, being ſituate very high, ſeven Leagues in Compaſs, and all ſurrounded with high and inacceſſible Hills, only on the one Side there is a ſmall Avenue after having paſt a very difficult Aſcent. In it's ſpacious Fields, on the Top, there be many fine Brooks of Water, Wood, Paſture-ground, Commons, and Waſtes, very commodious for the Support of Human Life.

CHAP. XVIII.

Of the Generation of Metals.

IT is no Wonder, that learned Men differ ſo much in their Opinions, about the Matter whereof Metals are engendred, becauſe the Author of Nature ſeems to have created them in that Obſcurity, and Depth, and to have immur'd them with hard Rocks on Purpoſe to hide their Cauſes, and to give Check to the Ambition of Man.

The Philoſophers, who pretend to know the Cauſes of Things, beſides the firſt Matter, which is the firſt Principle, not only of Metals, but of all other Bodies in the World, aſſign another Matter remote alſo, which is a certain moiſt and unctuous Exhalation, together with a Portion of thick and tough Earth, from which, being mingled together, there reſults a Matter, whereof not only Metals, but alſo Stones are made; for if the Drineſs prevail, Stones are begotted; but if the unctuous Humidity be predominant, then Metals are begotten: *Plato*, *Ariſtotle*, and their Followers are of this Opinion.

From the Abundance of this pure and ſhining Moiſture, made ſolid, proceeds the Luſtre of Metals, in whom, of all the Elements, Water is experimentally known to be moſt predominant, and therefore they run, and are diſſolv'd by the Fire.

From the various Temperament and Purity of the aforeſaid Matter, comes the divers kinds of Metals; the moſt pure and fine of all which, and, as it would ſeem, Nature's principal Intention, is Gold.

Many to avoid difficult Diſputes of this Nature, do hold with the Vulgar; that at the Creation of the World God Almighty made the Veins of Metals in the ſame Condition as we now find them at this Day; herein doing Nature a great Affront, by denying her, without Reaſon, a productive Virtue in this Matter, which is allow'd unto her in all other ſublunary Things; moreover, that Experience in divers Places hath manifeſted the contrary. A clear Example whereof we have in *Ilva*, an Iland adjoining unto *Tuſcany*, full of Iron Mines, which when they have dug as hollow, and as deep as they can, the circumjacent Earth falls in, and fills them up again; and in the Space of ten or fifteen Years at moſt, they work thoſe Mines again, and thence draw out abundance of Metal, which this new Earth hath been converted into; many do think the ſame happens in the rich Hill in *Potoſi*; at the leaſt all of us know, that the Stones, which divers Years we have left behind us, thinking there was not Plate enough in them to make it worth our Labour, we now bring home, and find Abundance of Plate in them, which can be attributed to nothing but to the perpetual Generation of Silver.

The Alchymiſts, a Name grown odious, by Reaſon of the Multitude of ignorant Pretenders to that Art, with more profound and practical Philoſophy have anatomiz'd the Mixtures of Nature, and reduc'd them from their firſt Principles; and concerning the Matter of Metals, do diſcourſe in the Manner following: The Sun, they ſay, and all the Stars with their Light, proper, or borrow'd, continually going round the Earth, doth heat the ſame, and with their ſubtil Rays penetrate through it's Veins; and we ſee things long burnt in the Fire, are converted into other terene Subſtances, as Wood and Stone, into Lime and Aſhes; ſo in like manner the Earth calcined by the Celeſtial Bodies, mingled and boiled with Water, changes itſelf into the other kind of Species, that contains in itſelf ſomething of the Subſtance of Salt and Alum. Every Day we ſee the ſame Effects in the Lees made of Lime, Aſhes, Sweat and

Urine, all which by boiling, get the Taſte of Salt. This firſt Matter, or Foundation of the Generation of Metals in Vitriol, which is eaſier to believe, ſince we ſee that all of them by Art may be reduced thereunto, and the Manner of reducing ſome of them ſhall be declar'd hereafter.

This Vitriol by the Heat of ſubterranean Fire, and Attraction of the heavenly, ſends forth two Fumes or Vapours; the one earthy, ſubtil, and unctuous, and ſomething digeſted, which the Philoſophers call Sulphur, becauſe it hath the Qualities thereof: The other Vapour is moiſt, wateriſh, ſlimy, and mingled with very fine Earth; and this is the next Matter, whereof Quickſilver is made. If theſe two vaporous Exhalations do find a free and wide Paſſage out of the Earth, then being carry'd up into the Region of the Air, they are converted into Comets, Clouds, Snow, Hail, Thunder, and other Things that appear there.

But if the aforeſaid Exhalations chance to be included between hard Rocks, in ſtrait and narrow Places, whence it cannot get out, or the Place be already full of Minerals, the ſaid Vapours will thicken, and be turn'd into thoſe they call half Minerals.

If theſe Fumes penetrating the Rocks, do not meet with a kind of clarify'd Brimſtone, that ſhines like Silver, and is ſomething like unto the Fire-ſtone, which the *Spaniards* call *Marcaſita* (without which no Metal can be engendred) they will ſtain the Rocks with ſeveral ſorts of Colours; if theſe Vapors aſcending, and endeavouring to get out meet with any Stones ſo hard as they cannot penetrate them, then they are converted into perpetual Springs of Water; the like Effect whereof we ſee in every common Still; but if when they paſs through the Rocks they meet with thoſe two Juices, namely the Fire-ſtone, or Brimſtone clarify'd and conſolidated, as hath been ſaid a little before, then it diſſolves the ſaid Juices, mixing itſelf with them, and after boiling together a convenient Time, it thickens and hardens in the Mine; this is the Doctrine of *Braceſco* in his Comment upon *Getro*; but the greateſt Number of Alchymiſts do affirm the immediate Matter of Metals to be Quickſilver and Sulpur, and that from the different Proportion of their Mixture, and greater or leſſer Purification, reſults the Difference that is found in Metals.

CHAP. XIX.

The Opinion that Quickſilver and Sulphur are the Matter whereof Metals are made, is defended.

THOSE that think nothing can be effected that comes not within the Compaſs of their own Capacity, a Preſumption very unworthy of learned Men, and much diminiſhing their Credit, who are poſſeſſed therewith, from Reaſons that neither convince nor are of any Force to deny, hold, that it is not poſſible by Art to change one ſort of Metal into another. It is not proper in this Place to examine all the Arguments of that kind, altho' the great Connexion they have with the right Knowledge of Metals, whereof we treat, makes it neceſſary to handle ſome of them, and to make the Weakneſs of their Foundation plainly to appear.

They ſay, that the Alchymiſts are ignorant of the Manner whereby Nature creates and brings Metals to perfection; and that it is erroneous to ſay, they are compounded of Quickſilver and Brimſtone, becauſe if it were ſo, there would be found in the Mines of Gold and Silver, and of other Metals, ſeveral Indications and Pieces of thoſe Juices; whereas common Experience ſhews the contrary; for Anſwer thereunto, the firſt Part of that Reaſon imports little; for though it be granted, it infers no more, but that thoſe Alchymiſts that went about thoſe Tranſmutations, proceeded mechanically, and without good Knowledge in the Art; but nevertheleſs it remains poſſible that ſuch Tranſmutation may be made.

The ſecond Part of the forementioned Reaſons ſhews plainly the great Raſhneſs wherewith they affirm that which they know very little of; for there is nothing more experimentally known concerning Metals, than their ordinary Mixture with Brimſtone; and the Abundance of Brimſtone in Minerals is an eſpecial good Sign of the Richneſs; a ſufficient Example whereof is the Roſe-colour'd Oar of the famous Mountain of *Sancta Iſabella* of new *Potoſi*, in the rich Province of the *Lipes*, which is almoſt all Plate, and engendred amongſt ſuch Abundance of Brimſtone, that the Cavities and hollow Places in the

Rocks are preſently on Fire, if a lighted Candle touch them.

All thoſe Oars which they call *Soroches Mulatos*, and *Negrilios*, and all ſuch as do touch upon Antimony, or the Fireſtone, are certainly known to abound in Sulphur, or Brimſtone, as ſhall be declar'd hereafter.

In the very ſame Manner is Quickſilver found incorporated with the Metals, altho' it be leſs taken Notice of, becauſe it is indiſcernable in the Oar, as it comes out of the Ground, and when it is put in the Fire, the Quickſilver fumes away, and leaves no Smell behind it, as the Sulphur does, but it's Effects are too well experimented in the Deſtruction of thoſe that labour in the Fumes where Oar is melted; and a few Years ago we have been undeceived in this Matter by the Oar of *Chalatiri* (which is four Leagues from the City, the moſt celebrated and rich one in the World, *Potoſi*) which being melted down, left in the Furnace a Bar of Silver, and alſo a great deal of Quickſilver, which they pick'd out of thoſe Aſhes that were cooleſt, the Plenty of Quickſilver there did expoſe itſelf to view; and afterwards taking more Pains to work in the ordinary Manner, it produc'd as much Quickſilver as the richeſt Stones of *Guancavilica*, where it is poſſible there may be much Reliques of Plate in the great Heaps of Oar, which hitherto they have refin'd; and I do not know whether ſome curious Perſon has not already by Accident found it ſo, when that that is already ſaid ſhall not be held ſufficient to clear this Point, it will bear no Weight in the Proof, that Metals are not compounded of Quickſilver and Brimſtone, to ſay that theſe two Ingredients are not met withal in the Mines; for as parts of the Compoſition of Metals they have already loſt their proper Forms, and are paſt into the Nature of that Oar, which is made up of them. But the moſt skilful Artiſts inquiring further into the Secrets of Nature, do again extract from all ſorts of Metal Quickſilver, whereof they ſay they are moſt viſibly and palpably compounded. I forbear to ſet down the Manner to avoid the occaſioning of Chymical Experiments, which do more harm than good. In like Manner common Quickſilver is turn'd into fine Plate, which is a certain Proof of the Poſſibility and Truth of what has been ſaid before, whereof there are ſo many Eye-witneſſes in theſe Provinces, that it were a Madneſs to disbelieve them all.

CHAP. XX.

Of the efficient and formal Cauſes of Metals.

BESIDES the Heavens, which as an univerſal Cauſe, concurs in the Generation of all Things, and particularly of Metal; ſome other nearer efficient Cauſe is neceſſary, that having receiv'd Virtue from the Planets, may work upon the proper Matter of Metals; for the Qualities of the Elements alone are not ſufficient, nor are appointed to produce any compounded Body, but only ſo far as they are govern'd by ſome other particular Virtue, as is manifeſtly ſeen in living

Creatures. This next Cauſe then, or mineral Virtue, or Spirit, ſerves itſelf on the elementary Qualities, eſpecially of Heat and Cold, for it's Inſtruments in the Generation of Metals; the Heat mixeth uniformly the earthy and humid Parts together, which is the Matter whereof Metals are made, then it boils, digeſts, and thickens that Matter, and the Cold coagulates and hardens it, and ſo it hath put on the Form of Metal, and is more or leſs perfect, according to the preſent Diſpoſition of that Matter when the mineral Spirit began to actuate it: Hereupon is grounded the Opinion of *Calliſthenes*, *Albertus Magnus*, and others, who ſay, there is only one kind of perfect Metal, which is Gold; and that all the others we call ſo, are but the Principles or Gradations unto that: Wherefore they conceive it feaſible by Art to reduce them to Perfection, and turn them into Gold: They that oppoſe the Poſſibility thereof, place the Force of their Arguments in proving that the ſeveral Species of Metals are compleat in themſelves, and diſtinct one from another; and therefore that a Tranſition of one to the other is impoſſible. But their Reaſon convinceth not, and if it were granted, the Inference would not follow; for we ſee the like Tranſmutations, and far more difficult, perform'd both by Art and Nature. By Art Waſps and Beetles are made of the Dung of Animals; and of the Plant *Alvaca* rightly placed and order'd Scorpions are produc'd. Alſo it is notoriouſly known, that in *Scotland* Pieces of old Ships and of Fruit that fall into the Sea turn into living Ducks; and there is no Compariſon between the Diſtance of things inanimate to Animals, and that of one Metal to another. Beſides many other Things that may be brought to this Purpoſe. It hath already been ſaid, how ſome Waters turn Sticks into Stones: And in the Nouriſhment of all living Creatures, there is a continual Tranſmutation: and in Metals it is evidenc'd by the Stone *Lipis*, or Copperas, blue or green, which, as hath been ſaid, being diſſolv'd in Water without any other Artifice turns Lead, Tin or Iron into fine Copper. And although it may be argued with Probability, that Metals do differ ſpecifically one from another, becauſe the Definition of Metal agrees to every one of them, as well as unto Gold, for the particular Properties that agree to every one of them. And for that we ſee them permanent, and without any Sign, as if Nature did endeavour to change one Form into another, or heighten them into Gold; and for many other Reaſons that might be alledg'd. Nevertheleſs, the contrary Opinion of *Calliſthenes* and *Albertus* are very probable; for it is not concluding, that two Things differ *in ſpecie*, becauſe the ſame Definition agrees to both of them, unleſs the eſſential Difference that conſtitutes them, ſuch be ſhewn therein. As if one aſſert a Man and a Lion to be Animals, he cannot truly infer from thence, that they are of different Species. For ſo *Peter* and *Paul* would be diſtinct in Specie, if it were not for the Differences of rational and irrational, that limit the Genius. So, although the Definition of Metal do agree unto Lead and Silver, as well as unto

Gold, one cannot thence rightly infer that they differ ſpecifically, becauſe the one may be perfect as Gold, and the other imperfect as all the other within the ſame Species of Metal, as a Child is in reſpect of a Man, though both have the ſame eſſential Definition; the Child may grow up to Perfection, and become a Man. The different Properties of Metals alſo does ſomething ſtumble one, ſince they are Accidents that accompany it's Imperfection, and ſo are capable of being removed; and the Permanency which they ſeem to have in their kind, proceeds firſt either from the ſlowneſs of their Growth, or Melioration, which comes not within the Compaſs of human Obſervation; when even the Growth of Vegetables is inobſervable, though after a great ſpace of time we can diſcern them to be increaſed. Or *ſecondly*, from the Covetouſneſs of Mankind, that digs the Metals out of the Bowels of the Earth before they be come to their full Maturity.

CHAP. XXI.

Divers Accidents of Metals.

BEING diſſolved and returning to be coagulated again, is one of the Accidents of Metals, though it be found in other things alſo, yet in Metals it is after a particular Manner; the Cauſe of this Accident is the Moiſture, whereof it is compoſed, the which as it is hardened by Cold, ſo it is diſſolved by the Heat of the Fire, with more or leſs Difficulty, according to the different Proportion, and ſtrong or weak Mixture of it with the earthy Subſtance. Tin has very much Moiſture in it, and is very ill mingled with earthy Subſtance, and from this laſt comes the Crackling and Noiſe it makes between the Teeth, when one bites it; and from both proceeds it's Facility to melt ſooner than all other Metals; next unto it Lead melts eaſier than ſilver, which hath need of a ſtronger Fire, becauſe it's earthy and humid Parts are well and ſtrongly compacted together, nothwithſtanding the humid doth a little exceed. Gold becauſe it hath a better Mixture of it's Parts, and Sulphur fixed in it's Compoſition, or it's earthy Part, the pureſt that can be is harder to melt than Silver. Iron, becauſe the earthy Part is groſs and impure, and exceeds the humid, and their Mixture alſo being ill and unequal, burns and conſumes as often as it is heated in the Fire, and will not melt of itſelf without extraordinary great Violence. Copper ſome do think to be a Metal very near of kin to Iron, and although it has a greater Proportion of Moiſture in it, it is ſlower in melting, becauſe it's earthy Part is very aduſt and burnt.

The Luſtre and Shining of all Metals proceeds, as it were, from one and the ſame Cauſe; for when their Superficies is made plain, and ſmooth, or burniſh'd, look how much the more pure and ſubtile the watry Part of the Metal is, ſo much the more Luſtre they give. Gold excels all other Metals in this, as well as in many other Particulars, and next it Silver. White is a Colour common to divers Metals, although Silver be moſt perfectly ſo, I cannot imagine with what ſort of Eyes *Cardanus* look'd, when it appear'd to him to be black; the Cauſe of Whiteneſs is the Moiſture being terminated by the dry, fine, and well digeſted earthy Part; for if it were dirty, impure, combuſt, it would produce a blacker and duskyer Colour, and according to the Difference of the earthy Parts of Metals herein, ſo do their Colour come out more or leſs white. Gold is yellow, or red, which Colour proceeds from the Tincture that the Sulphur very much boil'd gives unto the Quickſilver, or moiſt Parts, whereof it is compoſed; as we ſee in all ſorts of Leigh, Urine, and other Liquors boil'd upon ſtrong Fires, that they have a red Colour infuſed from the earthy Subſtance, wherewith they are mingled; the Colour of Copper proceeds from the ſame Principle, although by Reaſon of the Impurity, Combuſtion, and ill Mixture of it's Parts, it does not arrive at the Colour of Gold, much leſs to it's Richneſs and other noble Qualities.

Generally Metals neither taſte nor ſmell well, becauſe of their ſulphurious Quality, although Gold ſmells and taſtes well, by reaſon of it's moſt excellent Temperature; or at the leaſt, it neither ſmells nor taſtes ill, from the ſame Cauſe alſo Metals ſoil and black ones Hands, or any other thing that touches them; but herein alſo Gold muſt be excepted, becauſe of it's incomparable Purity; another Propriety of Metals is to be ductile or malleable, which proceeds from the Moiſture being incloſed in the dry Parts, which upon the ſtroke of the Hammer gives way, and changes Place, from whence proceeds the enlarging of the Metal. Of all Metals, Gold is the moſt ductile, next Silver, then fine Copper, Iron, Tin, Lead, &c. Metals burn and are conſum'd in the Fire from unctuous Sulphur or earthy Parts; as on the contrary, thoſe Parts they have of Moiſture or Quickſilver does defend and preſerve them from it; the Parts of Gold and Silver are ſo pure and ſtrongly compacted together, ſo that the earthy Part defends the moiſt from evaporating, and the Moiſture protects the earthy Parts from burning, and ſo they indure the Fire without any Diminution or Corruption. Other Metals waſte in the Fire for wont of Perfection and Compactedneſs of the Parts whereof they are compoſed.

CHAP. XXII.

Of the Number of Metals, and the Places wherein they are engendered.

THOSE who are vainly curious attributing unto the Stars and Planets particular Influence and Dominion over all ſublunary Things, do appropriate the Production of precious Stones to the Superintendency of the fixed Stars, who ſeem to imitate them, not only in their Brightneſs and Luſtre wherewith they twinckle, but principally in the Purity and Permanency of their Subſtance; as on the contrary, for the Inſtability and Alteration of Form in Metals, being ſometimes liquid, other times coagulated, they aſſign them to the particular Government of the Planets, (who from the variety of their Motions are called wandring Stars) moreover they aſſign the Number, Names, and Colours of the Planets unto Metals, calling Gold the Sun; Silver, the Moon; Copper, Venus; Iron, Mars; Lead, Saturn; Quickſilver, Mercury; although becauſe this laſt is not a Metal, ſome inſtead thereof call *Electrum* Mercury (which is a natural Mixture of God and Silver) which was heretofore eſteem'd the moſt precious of all Metals; but this Subordination and Application is uncertain, as is alſo the Conceit that Metals are but ſeven in number; whereas it is very probable, that in the Bowels of the Earth, there be more Sorts than we yet know. A few Years ago, in the Mountains of *Sudnos* in *Bohemia*, was found a Metal which they call *Biſſamuto*, which is a Metal between Tin and Lead, and yet diſtinct from them both; there are but few that know of it, and it is very poſſible more Metals alſo may have eſcaped the Notice of the Generality. And if one ſhould admit the Subordination and Reſemblance between Metals and the Planets, modern Experience, by excellent Teleſcopes has diſcovered, that they are more than ſeven. *Gallileo de Galiles* has written a Treatiſe of the Satellites of *Jupiter*, where one may find curious Obſervations of the Number and Motion of thoſe new Planets.

Reaſon and Experience teacheth, that the moſt proper Place for the Generation of Metals is the Veins of the Earth, which do run thro' it's great body as principal Receptacles of it's permanent Humidity, proportionable to it's Solidity and Hardneſs, as Blood is in the Bodies of Animals. The Rocks between which Metals commonly are engender'd, which they call *Caxas*, (or Cheſt) ſerve for Conduits, where ſubterraneal and celeſtial Heat meet and unite the one with the other, ſtirring up Vapours, mingling and purifying the Matter of which Metals are made, without giving it time to divert and diſſipate into ſeveral places; that which communicates between Cheſt and Cheſt is called a Vein; and that which time has moulder'd off, or the Rains carried away from the Matter that fills it, is found ſcatter'd up and down the Mountains broken, and tumbled away by themſelves, which are the Stones of Metal; thoſe that underſtand this Art beſt, believe that the Gold that is found in the Sands of Rivers, has the like Original, that it is not engender'd in the Sand, as divers will have it, but in Veins of the Earth carried from thence by Rains unto the Brooks; yet be this how it will, (although what has been ſaid, is the more natural and ordinary way of proceeding) oftentimes it happens, that in ſome parts or bits of Land, they find that which is called *Creoderos*, where Metals are engender'd out of Veins by the Diſpoſition of Matter, and the powerfulneſs of the mineral Virtue which there meet together.

CHAP. XXIII.

The manner how to find out the Veins of Metals.

THE Veins of Metals are diſcovered either by Art or Fortune. Violent Currents of Water waſh off the firſt Coat of the Earth, and ſo leave the Veins of Metal naked to the Eye, if there be any there; great Storms of Wind many times tear Trees up by the Roots, and with them ſome Stones of the Metal of that Place: The ſame Effect alſo hath the falling of pieces of Cliffs and Rocks, caus'd either by Thunder-time, or great Rains, and waſh away the Cement that ſhould hold them together. Oftentimes rich Veins of Metal have been diſcovered by the Plough, whereof *Juſtin* makes mention of Gold that was found in *Spain*. In my own Ground, a quarter of a League from *Chuquiſcaca*, ploughing upon the Ridge of a Hill, I diſcovered a Vein of *Soroches*, and 'tis very probable that the like happens in divers other Parts of theſe Provinces, which are ſo fertile of Minerals; and that the Ignorance of the Ploughmen hath been the Cauſe they have not profited by the Riches which Fortune hath put into their Hands. *Lucretio* in elegant Verſes hath ſet forth, how that the Mountains being ſet on fire, either on purpoſe, or by chance, diſcovered the Nature of Metals unto the World, melting them, and making them to run out of the Rocks wherein they lay concealed, into the Form that now they are known. By the ſame accident alſo have been, and may be hereafter, becauſe of diſcovering the Veins of Metals, which the Hiſtories of *Spain* confirm unto us in the burning of the *Pyrenean* Mountains; and much leſſer Violences than thoſe have been ſufficient, when Fortune has had a mind to diſtribute Riches to her Favourites. A Man riding a Horſeback over the Country in *Goſolaria*, by the Soil broken with the ſmall Force of his Horſes Feet, diſcovered a very rich Mine, as *Agricola* reports. An *Indian* Servant of mine pulling up by the Roots ſome Buſhes of *Tola*, a Sort of Wood, ordinary in this Country, together with the Roots, pluck'd up a rich Stone of Metal, which was Silver, white, and in Duſt; this was half a League from the Mines of St *Chriſtopher de Achacalle*; he brought me home the Stone, whereby I diſcovered the Vein of Silver, and ſhewed the place unto the Officers of the Mines.

When the rich Mines of *Tuno*, in the Province of *Carangas*, began to be famous for the Riches, abundance of Soldiers flock'd down thither: ſome of them being very poor, fortuning to have no ſhare in the Veins that were already diſcovered, and conferring together how they ſhould get their living, ſaith one of them; if God pleaſe, here we ſhall get enough to maintain us; together with which he kick'd the Ground with his Foot, and under that ſmall deal of Earth, which ſo ſlight a blow could turn up, they ſaw a piece of white Silver, which they took up, with incredible Admiration, and therewith ſupplied their preſent Occaſions, without any farther labour, (the Piece of Silver being about the bigneſs of *Botijuela* *) and afterwards the Vein of Silver in Duſt, which was found underneath that Stone (or rather pure Silver) yielded much riches both to them and others. That Mine is called the poor Man's Mine, and is the Richeſt of all that were in that famous Farm. The Mine of St *Chriſtopher*'s in the *Lipes*, was alſo found out by chance; amongſt the Rocks thereof, breed great ſtore of *Biſcaches*, a little Creature about the bigneſs of a Hare, (Game very ordinary, and of good Nouriſhment in theſe Parts) one of theſe being kill'd with a Gun, the Man that ſhot her, found her dead upon a rich [*farellon*] of Silver, and called this Vein, *Neuſtra Seniora de la Candelaria diſcubredora*, afterwards they regiſter'd divers other Mines, which made that Farm ſo deſervedly famous, as that abundance of *Spaniards* reſorted thither; and that it is reckoned the third beſt Mine in all the *Indies*, namely, next unto *Potoſi* and *Oruro*.

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* Botijuela *is a* Spaniſh *Veſſel, which contains about a Gallon.*

CHAP. XXIV.

Beſides thoſe Veins of Metal, which do diſcover themſelves, or are found by chance, as has been ſaid before, there be others procured by the art and induſtry of Man.

THE Colour of the ſuperficial Earth is no ſmall Indication, whether or no there be Metal in the Bowels of it, as has been ſaid in the firſt Chapter of this Treatiſe, and hath been found by experience in all the Mines hitherto diſcovered in this Kingdom, the ſuperficial Earth of them being of a far different Aſpect from other Earth, even to the ſight of thoſe who are very little vers'd in this Matter. There is no certain infallible Rule by the Colour of the Earth, to judge what kind of Metal it contains, that being only to be known by experience and enſaying, as we ſee in Gold, which is ordinarily found in red Earth, or yellow tinctur'd with red, like unto a hard burnt Brick; nevertheleſs in the Mines of *Oruro* and *Chianta* the Veins of it are found in white Chalk; in theſe Provinces the Earth of other Minerals moſt commonly is reddiſh, of the colour of Wheat, after the Pattern of *Potoſi*, (their firſt Copy) of the ſame Colour is that of *Seapi*, *Perira*, and others in the *Lipes*, which produce Copper; and although ſometimes the Earth is found of grey, green, and red Colour; yet generally it is of the Colour of Wheat. The very ſame kind of Earth likewiſe is found in the Lead Mines; ſo that the true knowledge of what Species the Metal is, depends upon the enſaying of the Oar.

The Veins of Metal are found ſometimes above Ground in great Stones, which being broken, the Miner diſcerns that they contain Metal and enſays them, and ſinks his Mine there, if he finds encouragement, and that it is like to be profitable; but if the Veins be covered, they hunt them out after this manner, *viz.* taking in their Hands a ſort of Mattock, which hath a ſteel Point at one end to dig withal, and a blunt Head at the other break Stones withal, they go to the Hollows of the Mountains, where the downfall of the Rains deſcends, or to ſome other part of the Skirts of the Mountains, and there obſerve what Stones they meet withal, and break in pieces thoſe that ſeem to have any Metal in them; whereof they find many times both midling ſort of Stones, and ſmall ones alſo of Metal. Then they conſider the Situation of that Place, and whence thoſe Stones can tumble, which of neceſſity muſt be from higher Ground, and follow the tract of theſe Stones up the Hill, as long as they can find any of them, and when they are gotten ſo high, that no more of theſe Stones appear, it is a certain Sign, that there or thereabouts begins the Vein, there then they break Earth, and run their Mines according as the Veins of Metal which they meet withal guide them.

The guſhing out of Water in the Sides of the Hills are very good Signs, that the Veins of Metal are near, becauſe commonly they are the Conduit-pipes of them.

When Trees, Buſhes, and other Plants, and Weeds of the ſame Sort, are found to run along in Rows, as if they were planted by a Line, oftentimes it proves, that a Vein of Metal runs underneath them.

The Plants that grow over the Veins of Metals, are not of ſo great a Growth, nor ſo ſtrong a Colour, as others of that kind, becauſe the Exhalations which come from the Veins, blaſt them and hinder their Perfection; for the ſame Reaſon alſo, the morning Dew, and the Snow which falls, is gone ſooner from thoſe Mountains that have Mines, than from thoſe that have none, and from the Place where the Veins run, ſooner than from other Places of the ſame Mountain.

CHAP. XXV.

Of the ſeveral Sorts of Veins; and how to find them out

ALthough the Word Vein be a general Term given to all Places, that contain Metal, yet in the particular Speech of the Miners, it is applied to thoſe Veins that run down perpendicularly, or ſloping; (which is more uſual) from the Horizon, and thoſe Veins which run parallel in the Ground, without any conſiderable Depreſſion from the Horizon, they call *Manto*, (a Word which ſignifies a Cloak or Blanket, which the Women in *Spain* throw over their Heads and Shoulders.) Both theſe Sorts of Veins are uſually found, altho' moſt commonly the Mines that are wrought, are thoſe that run downwards; thoſe Veins which are found ſeldomeſt of all, are thoſe the *Spaniards* call *Sombreros* (which in their Language ſignifies a Hat) or a heaped Mine, which is where Metal is found in a lump together, in what Quantity or Diſtance ſoever, from which no Veins run, either downward or ſideways.

In what vertical Plains the Veins of Metals generally run, hath been curiouſly obſerved by all the Miners of *Europe*, as being certain Signs of the greater or leſſer Riches, and abundance of the Mine, eſteeming principally thoſe Veins that run from Eaſt to Weſt, or thereabouts, in the northern Part of the Mountain; next they eſteemed thoſe beſt (in the northern Part of the Mountain) that run North and South, or thereabouts. They gave the third Place of Eſtimation to thoſe Veins which run North and South, on the eaſtern Side of the Mountains, and valued thoſe little or nothing at all which ran the contrary way. Whether the Veins do run Eaſt or Weſt, is eaſily ſeen by the Grain of the Stones in the joining of the Stones together, or Cheſts that contain the Metal, becauſe that runs towards the Part where the Mine ends; a thing eaſy to be obſerved in the pieces of the Rocks that are found above the Superficies of the Earth; and thoſe within the Bowels of it, run after the ſame Manner; other ſuch like Signs they give us, whereby to know thoſe Brooks or Rivers that have Gold in them, but with leſs reaſon, becauſe the Gold is not engendred there, but in the Veins of the Mountains, from whence time and the downfalls of Water have worn it away; but without diſparaging the Judgment of thoſe that have thought as aboveſaid, and have written to that purpoſe, I ſay, that for the moſt part in the Mines of *Europe*, and of theſe Parts, experience hath ſhewed the contrary; which I foreſee they will anſwer, by ſaying, that oftentimes an Effect is produced contrary to Expectation, and that theſe have their Exceptions as well as other Rules; nevertheleſs if it be lawful for us in this other World, and oppoſite Climate, to make new Rules from the Experiences in the rich Mines of *Potoſi*, I ſhould aſſign the firſt Place of Riches, and abundance to thoſe Veins that run North and South upon the northern Side of the Mountain; which point of the Compaſs, with a very little Declination weſtward, the four principal Mines of this Mountain obſerve; namely, the Mine of *Centeno*, which was the *Deſcubridora*; the rich Mine; the Tin Mine; and the Mine of *Mendieta*; the ſecond Place I ſhould give to them that run North and South, on the South Side of the Hills. A Point of the Compaſs parallel, whereunto run the beſt Veins of the ſecond famous Mine of this Kingdom, which hath it's Name from the famous City of St *Philip* of *Auſtria* called *Oruro*, which in the richneſs of it's Veins, abundance of Metals, Depth of it's Mines, and great Concourſe of Inhabitants, deſervedly ſtands in competition with the Grandeur of *Potoſi*.

In divers Places very rich Veins of Metal run Eaſt and Weſt, and alſo to ſeveral other Points of the Compaſs ſo that the beſt Rule to go by in this Matter, is to follow the Metal as it diſcovers itſelf, and as long as one gains thereby, or at leaſt ſaves himſelf, it is worth the following on, becauſe being ſure to loſe nothing one hath, the Vein will lead him to great Riches; and if the Vein be large, and have any Signs of Gold or Silver in it, altho' for the preſent it doth not quit the coſt, Men go on couragiouſly in the working of it, having ſuch certain hopes of gaining great Profit; this hath been confirmed by experience in all the Mines of theſe Provinces; a freſh Inſtance whereof we have in the rich Mine of *Chocaia*, (where for the inſtruction and encouragement of Miners) after having followed it's Veins forty Years, with very little Profit, at length they have met with the extravagant Riches, which all of us in this Kingdom have heard and ſeen. If the Veins of Metal be very ſmall, they muſt be extream rich to be worth the following: If the Metal be found clinging about Stones, and likewiſe in the hollows of thoſe Stones, it is found in Grains like Corns of Gunpowder, (being that which the *Spaniards* call *Plomo*) and is Silver unrefin'd; altho' theſe Grains be but few, and the reſt of the Metal have no Silver in it, nevertheleſs it is a Sign of the Riches of the Vein, when it meets with more Moiſture. As it fell out in that great Mine of St *Chriſtopher* of the *Lipes*, which they call the poor Man's Treaſure, if as they dig forwards they meet with more abundance of thoſe Grains, *de Plomo*, it is a Sign that the rich Oar is very near. To find *Chriſecola*, *Herrumbre*, *Oropimente* or *Sandaraca* in the Mines, or Iron-coulour'd Earth, next to the Stones that incloſe the Oar, or Fullers Earth between thoſe Stones, are very good Tokens of the Richneſs of the Mine; it is no ill Sign alſo to meet with dry Earth, if it be yellow, red, black, or any other extraordinary Colour, and it is the better when there is ſome ſhew of Lead mix'd with it; Chalky Ground is very promiſing, and *Agricula* doth judge it a good Sign to meet with Sand in the Mines, if it be exceeding fine, and very ill to meet with Earth full of little Flints, if it hold long, without changing into another ſoil.

CHAP. XXVI.

Of Metals in particular; and firſt of Gold.

THE moſt perfect of all inanimate Bodies, and the moſt eſteem'd of all Metals is Gold, univerſally known, and coveted by all People. It is made of the ſame Matter, and in the ſame Manner as other Metals are, (as hath been already ſhewn) but of Parts ſo pure and perfect, and ſo well compacted together by Decoction, that it's Subſtance is, as it were, incorruptible, being out of the Power of any of the Elements to be corrupted or deſtroy'd.

ſtroy'd. The Fire that conſumes all other Metals, only makes Gold more pure; the Air and Water diminiſh not it's Luſtre, nor can Earth make it ruſt or waſte. By the nobleneſs of it's Subſtance, it hath moſt deſervedly obtained that Eſtimation, which the World gives it, and the natural Virtue which flows from the admirable Equality of it's Compoſition, is the beſt Medicine againſt Melancholy, and the greateſt Cordial to the Hearts of Men, which perpetually run after this avaritious Metal, as the Needle doth after the Loadſtone. The Qualities that it hath in common with other Metals, have been briefly touched Chap. 21. The Virtue aſcribed to *Aurum potabile* to preſerve a Body perpetually in Youthfulneſs, without Infirmity; together with the Receipt of making thereof, depends upon the Credit of thoſe Authors, who have written concerning the ſame. Many Writers upon this Subject relate the Names of divers Countries, Mountains, and Rivers, famous for the Production of Gold, but my Deſign is not to be over large; and therefore I not only forbear to tranſlate what other Men have written, but alſo to treat of the greateſt Part of the Mines in this new World, even thoſe of divers of the Provinces of *Peru*; and only apply myſelf to give your Lordſhip a ſhort Account of thoſe which are found in the Royal *audiencia de los Charcas*, the Government whereof is worthily committed unto the Care of your Lordſhip. Every body knows the Name of *Carabaya* for being a Country ſtored with plenty of the fineſt Gold, as fine as the fineſt of *Arabia*, it is of the *ley* of 23 *Carrats*, and three Grains; and although an incredible Quantity thereof hath been, and daily is gotten thence, yet now they begin to Work again a-freſh, and follow the Veins of it under Ground, whereas hitherto they have only gather'd up the Fragments of it, which were waſh'd off by the Rains. The Province of *Larecaja* borders upon *Carabaya*, and abounds with Gold, which in divers Brooks of that Country is found in Form and Colour like unto ſmall Shot, which being melted, and it's outward Coat and Mixture conſum'd away, becomes of a red Colour; he that found this firſt did not know it to be Gold, until a Friend of his, unto whom I diſcover'd it, told him ſo.

Next unto *Larecaja* joins *Tipuane*, a Country inhabited by ſavage *Indians*, with whom we have had Wars, and made Incurſions upon them, ever ſince the building of the City *de la Paz*, where I was preſent, and is now above twenty Years ago; this Country is ſo largely reported to be rich in Gold, that it were incredible, unleſs ſo many Eye-wineſſes had affirm'd it; the proper Name of this City *de la Paz*, is *Chaquiyapu*, which we corruptly call *Chuquiabo*, which in the Language of this Country is as much to ſay *Chacra*, or the Farm of Gold; it hath abundance of Mines in it, that were wrought in the Time of the *Ingas*; it is a ſoil generally known to be fertile of Metals; and in the time of the Rains the Boys often pick up Gold in the Streets in ſmall Bits, like the Kernels of Apples, eſpecially in that Street that goes down to the River, by the Convent of the *Predicadores*; and in the Valley of *Coroico*, and others, which they call *andes de Chuquiabo*, in the Cliffs or the Rocks Gold is found of a grey Colour on the Outſide, like unto Lead. The Silver Mines of the famous Town of St *Philip* of *Auſtria*, *Oruro*, are encompaſs'd round about with other Hills, in which there are many rich Veins of pure Gold, which have been wrought heretofore; at preſent there is only one wrought, and that by my Perſuaſion; upon the Ridge of that Mountain, that runs over the Silver-mills, which they call *de las Sepolturas*, the Oar whereof being well ground to Powder, and enſay'd by Quickſilver, yields a conſiderable Profit, they have not follow'd any more of the Veins, for want of Induſtry, their common Trade being getting of Silver, or which I rather believe, becauſe in thoſe Veins they have already wrought, they have not gotten ſo much Gold as they expected; although that ought not to diſcourage them, becauſe it may reaſonably be ſuppoſed, that where ſo many Veins of Gold are, there be ſome of them very rich, if they have the good Fortune to light upon them, the ſame which daily Experience hath ſhew'd in the Mines of Silver.

The Bounds of *Chayanta* are full of Veins of Gold, and have ſome ancient Mines already ſunk in them, and in the Sands of it's River, which is call'd, *el Rio grande*, Kernels of Gold are found, and in the River of *Tinquepaya*, ſeven Leagues from this City of *Potoſi*, they have found Gold alſo.

In the Confines of *Paccha*, *Chuquichuqui*, and *Preſto*, near unto the City of *Chuquiſaca*, there be many Caves, out of which they have gotten ſome Shew of Gold; the like alſo is found from the River *Sopachuy*, up unto the *Chiriguanes*, where it is held for certain, that there be rich Mines of Gold, which the *Indians* have this Year offer'd to diſcover unto us.

The River of St *Juan*, which runs at the Bottom of the Province of the *Chiquas*, where it joins with the *Calchaguies*, is very full of Gold; in *Eſmoraca*, and *Chillo*, of the ſame Province the ancient Gold Mines are yet to be ſeen; there is one Hill of the *Lipes*, which is near unto *Colcha*, which hath Gold in it; there is a Mine alſo three Leagues from this Town, in a Place they call *Abitanis*, which in the *Lipean* Language is as much as to ſay, the Mine of Gold. I believe for a certain alſo, that there is Gold in the Province of *Atacama*, becauſe of the abundance of fine *Lapis Lazuli*, which is found there, in which Gold is engendred.

CHAP. XXVII.

Of Silver, and the Mines thereof.

SILVER is the moſt perfect of all Metals, except Gold, whereunto it comes ſo near, as to want nothing but the Colour; and therefore thoſe that moſt of all oppoſe the Opinion of the Tranſmutation of Metals one into another, do yet hold it poſſible to turn Silver into Gold, becauſe the Colour only being wanting, the Fire, and artificial Concoctions can ſupply that, whereof there be many Experiments; from the good mixture and fineneſs of it's Parts, proceeds it's enduring the Fire with very little waſte, as alſo it's being tough and malleable, and endures the drawing out into very thin Leaves, and ſmall Wire; if it were not a common Trade to do it, it would not be believed to be poſſible, that an Ounce of Silver ſhould be drawn out into 1400 Yards of Wire; and it is yet more admirable, that all that ſhall be made gilt Wire, with only ſix grains of Gold; ſo that although Silver can be extended to Admiration, yet Gold is a hundred times more ductile than it; one Ounce of Gold ſuffering itſelf to be beaten to that thinneſs, as to overſpread ten *Hanegadas* of Land.

In the Mines oftentimes Silver is found white and pure, and like, as it were, Wire woven one within the other between the Rocks, which the *Spaniards* call *Metal Machacada*, ſuch as is found in that Mine they call the *Turks*, in the Province of *Carangas*; in *Choquepina* a Mine of the *Ingas*, two Leagues from *Berenguela*, in the Province of the *Pacages*; in the Mountain that I diſcover'd and regiſtred, half a league from the Works of St *Chriſtopher*, in the Province of the *Lipes*; in *Yaco*, of the Province of the *Charcas*; which in the middle of it's Oar yields rich Copper, there was found laſt Year a Stone coated over with white Silver, the Metal contain'd within, being yellow, like unto the Colour of a Lion. And in the rich Mine of *Chocaya*, in the Province of the *Chichas*, in the richeſt Stones of that Oar they have found much Silver, like Wire woven together as aforeſaid, and in all the Mines of theſe Provinces at ſome time or other Stones have been found made into Silver Wire as aforeſaid; and Wedges of pure Silver; but no other Mine hath produced the like unto that of St *Chriſtopher*'s in *Oruro*, which beſides the Leaves of fine Silver, that are found between the Stones, produceth fine Silver alſo in ſmall Duſt, mingled with the Mould or Earth, that is dug there, which may be gotten together without any more Trouble than Waſhing, in the ſame manner as they uſe the Gold that is found in Sand; but moſt commonly in all Mines Silver is found incorporated with the Stones, and is ſcarce diſcernable, nor to be known, but by Men of good Experience. In the Circuit of the *Charcas*, there is ſuch abundance of Silver Mines, that they alone, if there were no other in the World, were ſufficient to fill it with Riches; in the middle of this Juriſdiction ſtands the wonderful Mountain of *Potoſi*, of whoſe Treaſure all Nations of the World have liberally participated; the Excellencies whereof and of that imperial City, whereunto it hath given the Name, do ſo much ſurmount any other thing in the old, or new World, that they very well deſerve a particular Hiſtory to eternize their Fame; it is ſurrounded for the moſt part, with abundance of rich Mines, that of *Porco* is the famous Mine of the *Ingas*, and the firſt, out of which the *Spaniards* dug any Silver; thoſe very ancient Mines of *Andacava* are admired by all Miners for their vaſt Depth, and admirable Contrivance, and plenty of Oar, which is ſuch as promiſes continual Employment, for half the *Indians* of this

Kingdom. Thoſe of *Tabacco Nunio* are near unto a Lake call'd by the ſame Name, have ſuch wonderful and coſtly Engines appertaining to them, that the building of them hath conſumed a great Part of the Treaſure of this Kingdom; that Lake contains ſo much Water, as would make a running River all the Year long, with which there goes Day and Night a hundred Silver-mills, which grind the Oar that is gotten from it's own Banks. Within the Bounds of *Potoſi* alſo are the Mines of *Guariguare*, *Caricary*, *Piquiza*, *la vera Cruz*, *Siꝑoto*, and many others.

In the *Lipes* there be Farms of Mines of greater Fame, namely that of St *Iſabel* of new *Potoſi*, the Name whereof doth not more predicate it's Beauty, than doth the Amenity of the Mountain; and the richneſs of the Oar that is found there. *La Trinidad* is a wonderful rich Mine, there be alſo the Mines of *Eſmoruco*, *el Bonete*, which they call ſo, becauſe the Top of the Mountain is like a Bonnet.

Xanquegua, the new World, which hath been diſcovered in my Time, yields very rich Veins of Metal; namely, *Abilcha*, *todos Santos*, *Oſloque*, *St Chriſtoval*, *de Achocalia*, *Sabalcha*, *Montes claros*, and many others. In the *Chicas* are St *Vincent*, *Tataſi*, *Monſerrat*, *Eſmoraca*, *Taſna*, *Sbina*, *Chorolque*, old and new *Chocaya*, which to the Shame and Aſtoniſhment of the Miners, hath been now laſt of all found out, and is one of the richeſt in all *Peru*.

CHAP. XXVIII.

Continuing the Diſcourſe of the laſt Chapter, touching the Mines of Silver.

THE Province of the *Charcas*, beſides the rich Mountain of *Potoſi*, which alone was ſufficient to eternize it's Name, and the other Mines aforeſaid, that are round about it, hath alſo the Mines of *Yaco*, or the Mountain of Miracles, thoſe of *St Pedro de buena viſta*, and thoſe of *Malcocota* ; there is Silver Oar alſo found near unto *Cayanta*, and alſo in *Paccha*, and *Tarabuco*, not far from *Chuquiſaca*, and in other Places. Within the Juriſdiction of *Panna*, ſtand the three great Mountains, *St Chriſtoval*, *Pie de Gallo*, and *la Flamenca*, which together make up thoſe Mines, which they call of *Oruro*, that famous Town, which is near unto them. In the neighbourhood of *Oruro* alſo are the Mines of *Avicaya*, *Berenguela*, *Cicacica*, *la Hoya*, *y Colloquiri*, which although it is a Mine of Tin, yet now and then in following the Veins thereof they meet with rich Oar of Silver, which they call *Lipta* ; in the Province of the *Pacages* is the rich Mine of *Berenguela*, with the Mountains of *Santa*, *Juana*, *Tampaya*, and others, and in the Bounds of the City *de la Paz*, there are the Mines of *Choquepina*, *Pacocava*, *Paccocava*, *Tiaguanaco*, and divers others; briefly all theſe Provinces are nothing but a continued Mine, and notwithſtanding ſo great a Number of Mines are opened at this Day, yet it is certain, that there be many more known unto the *Indians*, which they craftily have concealed from us till this preſent.

There is a certain Tradition in this Country of an incomparable rich Mine belonging to the Village of *Chaqui*, four Leagues from this Imperial City, although at preſent the Sight of it is not known, divers *Indians* having kill'd themſelves out of Obſtinacy, that they might not diſcover it.

There goes no leſs Fame of the Mine, which they call *de los Encomenderos* in the Province of the *Lipes*, which Name was given it divers Years ago by the *Indians*, who getting a Quantity of Silver out of that Mine, gave that Treaſure unto two *Spaniards*, whom they diſpatch'd away into *Spain*, as their Agents, they were two Brothers of the Sirname of *Tapias*, whereupon this rich Province was incorporated into the Crown. Whilſt I was Curate of this Place, I ſpoke with many of the Country People, that told me, they had helped to load, and conduct that Riches unto the Port of *Arica*, where it was put on Shipboard; it is agreed on all Hands, that the abovesaid Report is true, although at preſent that Mine remains undiſcover'd, which I do not at all wonder at; when I conſider, that all the Mines that are wrought in that Province have been found out, and firſt taken Say of, by the *Spaniards* themſelves, without lighting upon any one ancient Work of the *Indians*; whereof no doubt there were formerly very rich ones, as appears by the choice Stones, and Pieces of Oar, which *Indians* have given me, without diſcovering whence they had them; and the very Streets of the Town, when I was Curate there, were full of ſmall Grains of rich Oar, which I ſwept up, and made Profit of it. In the Plains of *Julloma* in the *Pacages*, the *Indians* anciently have wrought Mines, which at this Day remain undiſcover'd. It hath been a vaſt Quantity of ſmall pieces of Plate, which they call *Corriente*, that the *Spaniards* have bought up, among this People, and I myſelf have gotten there ſome of the Remainders of that ſort of Silver; theſe Grounds, together with the Colour and Beauty of the Mountains, makes one rationally to ſuſpect that Country to be fertile of rich Metal; but it is more certain, that there are rich Mines in the Pariſh of *Caquingora*, in the ſame Province of the *Pacages*, becauſe I have ſeen Stones of rich Oar pick'd out of the Paving of their Streets, and the Walls of their Houſes. The ſame Report goes alſo of divers of the neighbouring Towns and a conſtant Fame, that in the Time of the *Ingas*, each of the Parties had their particular Mines.

CHAP. XXIX.

Of Copper, and the Mines thereof.

THE Sulphureous Parts do predominate in the Compoſition of Copper, and from their diſtempered Heat riſes the fiery Colour of that Metal; when it is melted it ſmells more of Brimſtone than any other Metal; and becauſe it is overburnt in it's Compoſition, therefore it is leſs ſubject to Injury or Corruption, by the Air, Earth, or Water; as for the ſame Reaſon, Coals are not Subject to ſuch like Accidents; they uſe Copper about Engines of long Duration, becauſe it never ruſteth as Steel and Iron doth; and for the ſame Reaſon it was highly eſteem'd by the Ancients, who made the Bolts and Nails of their Ships, their Weapons, and other Inſtruments, of this Metal, which alſo we found in uſe among the Natives of this Kingdom.

Copper is engendred in Mineral Stones of divers Colours, although ever the moſt predominant Colour is blew or green; it is engendred in the ſame Places with Gold and Silver, and oftentimes in following a Vein of pure Copper they have met with a Neſt of the fineſt Gold; but it is more familiar to have it's Veins change into Silver; and thoſe Veins of Copper that make any Shew above Ground, commonly prove very rich as they are dug deeper, and conſequently are more moiſt. The Mine of *Oſloquee* in the *Lipes*, was at the top in

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CHAP. XXX.

Of Iron.

IRON, although it is not the moſt precious, yet it is the moſt neceſſary of all Metals for the Uſe of Man; notwithſtanding it may be diſputed, whether the good or hurt it hath done in the World, be the greater; Nature hath made it ſo hard, by putting over much earthy Parts or fixed Sulphur in it'sComposition, although it hath alſo a ſufficient Portion of Humidity, or Quickſilver, ſo that in the firſt Place it will not melt without a very violent Heat; and, in the next Place, being ſtruck with a Hammer, it doth not break into ſmall Pieces, as hard Stones do, but receives Impreſſion, thereby dilating and extending itſelf. It is a Metal cold, and dry, but more porous than others, and therefore weighs leſs, and is more ſubject to ruſt, and decay in the wet: eſpecially in Salt Water, which penetrates moſt; it waſtes in the Fire alſo every time it is heated, falling off in Scales, becauſe it wants Humidity proportionable to it's Earthineſs. If when it is red hot, it be quenched in cold Water, it will become very brittle, becauſe the heat being pent up in the Heart of the Iron by the ambient Cold, doth there prey upon, and conſume part of the natural Moiſture, which made it tough and malleable.

Theſe fertile Provinces of all other Sorts of Metal are not deſtitute of this alſo, though none employ their Labours to ſeek it out, or work it; becauſe here is ſuch abundance of Silver, about which they are induſtrious to greater Profit, and in truck for it, they buy abundance of that excellent Iron of *Biſcay*; this proceeding is not to be wondred at, when one conſiders the abundance of Copperas, Allum, Quickſilver, and other Minerals, which is yearly brought from *Spain* to theſe *Indies*, where the ſame Commodities may be gotten in ſuch abundance, as were ſufficient to ſupply, not only the Occaſions of theſe Kingdoms, but alſo of *Spain* it's ſelf, and of all the World beſide.

In the Valley of *Oroncota*, there is a great deal of Iron, the People of the Country being encouraged by the looks of the Place, and fair appearance of the Oar they found, followed a large Vein of Metal, hoping that it was Silver, and brought me ſome of the Oar to enſay it, the which I did, and undeceived them, by telling them it was Iron; the ſame has happened in other Veins at the riſe of the River *Plicomayo*, five Leagues from the City *de la Plata*, although that Oar has ſome Copper mingled with it, and is not pure Iron as that of *Oroncota* is.

Adjoining to the *Ancoraymes*, a Town in the Province of *Omaſuyo*, there be noble Mines wrought formerly by the *Ingas*, of ſo great Fame, that it is very well worth one's making a Journey purpoſely to ſee them; the Oar is very heavy, and hard, and of a dark Colour, although there be found together with it much Oar, that ſparkles and ſhines. If you rub pieces of the dark Oar together, it produceth a very fine blood Colour, like that of the *Hemmotites*, to whoſe Species undoubtedly it belongs, and is full of Iron, as I have proved by many Enſays; it is poſſible the *Indians* followed Veins of richer Metal in theſe Mines, which hitherto we have not met withal, or becauſe Iron was not in uſe amongſt them; they dug this Our to fit it to their Guns, Stone-bows, and Slings; it being not inferior in weight or hardneſs to our Iron Bullets, they did make uſe of theſe in their Wars, and called them *Higuayes*.

In *Oruro*, hard by the Silver Mine of *Santa Brigida*, in the hollow between the Hills, there is a Vein of Iron, of which, out of Curioſity, and for Example only, when I was in that Town, I ſaw ſeveral Iron Keys made; the Metal which they call *Chumbri*, taken out of the Mine of *Chocaya* in this Mountain of *Potoſi*, and others, have much Iron in them; and doubtleſs there is abundance of Iron in many other Parts of this Kingdom, although the People do not regard, or ſeek after it, nor do the Miners in their ordinary Enſays meddle with any thing, but the Knowledge of Gold and Silver.

CHAP. XXXI.

Of Lead.

LEAD is a very common, and known Metal, there is no Silver Mine, where much of it is not found; and there is ſcarcely any other Oar but has ſome mixture of Lead in it. Nature hath qualified it with abundance of Humidity, that it might be ſerviceable in the melting of Gold and Silver, which, without the help of Lead burn, away and conſume in the Fire, before they arrive to their full Perfection. By reaſon of it's Moiſture, it doth eaſily evaporate in the Fire, and melts; carrying along with it whatſoever is not Gold, or Silver, and therefore it's ſelf is very eaſy to be refin'd; it is likeſt unto Gold in Weight, and unto Silver in Colour, being melted together with them. It not only facilitates the founding, and refines them, but ſeparates the Copper from them, as ſhall hereafter in it's place be ſhewn; and therefore is the moſt neceſſary of all Things in the Art of founding of Metals, the whiteneſs of it ſhews the abundance of Humidity, or impure Quickſilver, whereof it is compoſed, which the Chymiſts in ſeveral Manner of Ways do eaſily ſeparate from it.

It neither diminiſheth nor corrupts by the Air or Water like Iron, but rather increaſeth

Both in Weignt and Quantity, as very good Authors do affirm, notwithſtanding others do ſay, that Sheets of Lead expoſed to the Weather do waſte and conſume, and have been the ruin of many goodly Buildings covered therewith. It is rarely found mingled with Gold, moſt commonly with Silver, and ſometimes with Copper. The Oar in which Lead is engender'd, is called in this Country *Soroches*, which for the moſt part is black, full of Holes, and ſparkling; other pieces of it they call *Muertos*, becauſe it doth not ſparkle, nor is ſpungy? others they call *Oques*, which in the Language of this Country is as much as to ſay *Frayleſcos*, becauſe it is of the Colour of a Friers Coat; there hath been no Silver Mine diſcovered in all this Kingdom, wherein ſome Lead has not been found, in which regard it is needleſs to enumerate the ſeveral Places that afford this Metal, although moſt of the Mines in the *Chicas* have abounded therein, and therefore it is that they have founded ſo much Metal in this Province. The Mines of *Andacava* are Lead and Silver alſo, but becauſe that Oar is not proper to be ſeparated by Quickſilver, and there is not Wood enough near the Place to melt it down; this Mine, which in my Opinion is one of the richeſt in all the *Indies*, continues hitherto yielding but a very ſmall Profit. Below the Mountain of *Potoſi*, as far as it's Shadow reacheth in that Part called *Deſibicos*, there be many Veins of Lead, with a very little Silver mix'd in it; the like alſo there is within the Shadow of *St Chriſtomal de Oruro*.

CHAP. XXXII.

Of Tin.

THE Metal which we call Tin, divers call white Lead; particularly they give it this Name, that ſeparate Silver and Copper, in which Operation ſome Tin comes forth, as ſhall be ſaid in it's Place, which is known by it's whiteneſs, and the Noiſe it makes when one either bites or breaks it. Common Tin is begotten from the ſame Principles as Lead is, but more fine and better purified, whence it becomes more hard and white, although from the ill Mixture of it's Subſtance it is ſaid to ſtutter, and make a Noiſe as hath been ſaid; it is the Poiſon of Metals, and makes them brittle that have the leaſt Mixture of it, becauſe it's Incorporation with any Metal alters the equal Temper it had before, and impedes it's Ductibility; only it doth not infect Lead in this Manner, becauſe the exceeding great ſoftneſs and humidity thereof penetrates into, and incorporates with the ill-tempered Subſtance of the Tin, ſo that united together, they remain ductile and malleable. The Veins of Tin are not found in every Place that one hath a mind to; and yet theſe rich Provinces are not wholly deſtitute of them; there is a Farm of Mines named *de Colquiri*, not far from the Hill of *St Philip de Auſtria de Oruro*, which is famous for the abundance and excellency of the Tin, that hath been gotten there, wherewith they have furniſhed all this Kingdom, in following the Veins whereof, as hath been advertiſed before, many times they have met with rich parcels of Silver. Near unto *Chayanta* in the *Charcas*, there is another Mine, whence a few Years ago they got abundance of Tin. Not far from *Carabuco*, a Village on the Bank of the great Lake *Chucuito*, on that Side towards the Province of *Larecaja* there be Tin Mines alſo, which the *Indians* wrought in the time of the *Ingas*, and the *Spaniards* continue to work ſtill; thoſe Veins are very large, and rich in Tin, and many times amongſt it they meet with Silver; but all of it is mixed with Copper, which makes the Tin more ſightly and durable; the Fame of theſe rich Veins gave me the Curioſity to ſee them, being deſirous that no Mines of theſe Provinces ſhould eſcape my Knowledge and Experience. In the Mountain of *Pie de Gallo de Oruro*, there is much Tin, altho' few know it, and all neglect the working of it becauſe they find not the Silver there which they expect. One of the four principal Veins of this famous Mountain of *Potoſi*, is called the Tin Mine, becauſe of the abundance of Tin that was at firſt found upon the Superficies of the Earth, and in digging deeper it all turned into Silver. And in the Fields belonging to the Pariſh of St *Bernard*, where I officiate, a quarter of a League off, or a little more, there be rich Veins of Tin, which upon my diſcovery, your Lordſhip went in Perſon to viſit, whereby, as by other of your noble

Proceed-

Proccedings, you have given great Encouragement to thoſe that are induſtrious in the working of Mines, which hath ſo eminently increaſed the royal Revenue, and the Riches of the People.

CHAP. XXXIII.

Of Quickſilver.

QUickſilver is a Mineral very well known, of a liquid Subſtance, and fluid like Water; it is naturally viſcous, very ſubtile, and abounds in Humidity, whence it obtains the Qualities of being very heavy, and ſhining bright, and of being very cold, as it is generally thought, notwithſtanding ſome do affirm it to be very hot, by reaſon of the ſubtil Effects and penetrating Quality that it hath, whereby it runs thro', not only Fleſh, but the hardeſt Bones; and alſo becauſe ſublimated Mercury (which ſubſtantially is nothing elſe but Quickſilver, though altered by the Mixture of thoſe Minerals wherewith it is boiled and ſublimated and in like Manner is reducible again to Quickſilver) is notoriouſly known to be Poiſon, and hot in the firſt Degree; but leaving the Determination of this to thoſe that deal in Simples, it is certain, that there is ſo great an affinity between the Nature of Quickſilver, and that of other Metals, that though it be none of them, yet it is convertible into any of them, be-

becauſe as moſt Philoſophers hold, it is one of the Principles of which they all are compounded, and moſt eaſily unites and incorporates with them; and moreover it's very Subſtance is tranſmutable into true Metal, enduring the Trials of the Fire and Hammer, as well as thoſe that come out of the Mine. *Raymundus* teacheth ſeveral Ways how to turn it into Gold and Silver, in a Book called *La Diſquiſicion Eliana*, there is taught a very perfect Way how to make Lead of Quickſilver; and if one ſhould ſuſpect the Credit of Books, in theſe Provinces there be many Eye-witneſſes that have Plate by them, which they have refined with their own Hands by a Copel of Quickſilver, cured according to a Receipt given unto them; the which Experiments take away all Scruple of the Poſſibility of it's Tranſmutation. There was very little uſe or conſumption of Quickſilver before the beginning of this new Silver Age in the World; then they only waſted it in Mercury ſublimate, *Cinabrio*, or Vermillion, and the Powders made thereof called *Precipitate*, which are alſo called in *Spain* the Powders of *Juanes de Vigo*, which have been uſed to ſuch miſchievous Purpoſes, that the World was ſaid to have too much of them, although in bulk and quantity then they had but little, but ſince it hath been uſed to collect the Silver together out of Oar, which is ground ſmall, (an Invention which the Ancients had ſcarcely arrived to, and practiſed it but very little) it is incredible, how great a quantity is conſumed by the Founders of Metals of this Kingdom: For if the abundance of Silver that hath gone out of this

Kingdom, hath filled the World with Riches and Admiration; by it may be eſtimated the conſumption and loſs of Quickſilver, which after a moſt extravagant Expence thereof at firſt, being now by good Experience regulated within terms of Moderation, is found to be equal in weight to the Silver extracted; and very ſeldom that the waſte is ſolittle. They began to regiſter the Quickſilver that came to *Potoſi* upon the King's Account, in the Year 1574; and from that time till 1640, there had been received of it upwards of 204,600 Quintails, beſides a vaſt quantity irregularly brought in upon other Accounts; to ſupply the exceſſive Expence of this Mineral, God Almighty provided the famous Mine of *Guancavellica*, and in theſe Provinces ſubject to the *Charcas*, (of whoſe Minerals I have deſired particularly to inform your Lordſhip) there can be no want of this Mineral amidſt the great Plenty it hath of all others; there are Quickſilver Mines in *Challatiri*, four Leagues from this Imperial City; there be alſo of the ſame near unto *Guarina*, in the Province of *Omaſuyo*, and not far from *Moromoro*, a Village of the *Indians*, ſix Leagues from the City *Chuquiſaca*; a few Years ago the *Indians* brought Stones very rich with Quickſilver, which by the violent Death (as was ſuſpected) of the Man that proferred to diſcover the Mine, hath remained concealed unto this preſent.

CHAP. XXXIV.

Of artificial Metals and Metallics.

ART alſo produces Metals and Metalics, and in their Fabrick aims at, and imitates the Perfections of Nature. From a Mixture of Tin and Copper, is made Braſs for Bells, and for Pieces of Ordnance, and for other Uſes. They put a Pound of Tin from four to eight Pound of Copper, according as the Occaſion requires. The *Indians* underſtood this Compoſition, and made uſe of it for their Inſtruments of Force, and for their Arms, as we do of Steel or tempered Iron, which they knew nothing of.

Latten is made of ſmall pieces of Copper put into large Crucibles, covered with Powder of *Jalamina*, (which is a Semi-mineral of a yellow Colour; there is of it near the Mine called the *Turc*, in the Province of *Carangas*, and alſo near unto *Pitantora* in the *Charcas*) upon the Powder of *Jalamina* they ſtrew Powder of beaten Glaſs to cover it, and keep in the Reſpiration, and then they put Fire to it, which alters the Colour of the Copper, and makes an increaſe of Metal of eight Pound in the hundred Weight.

For Looking-glaſſes they make ſeveral Compoſitions, although the beſt is of two Parts Silver, and one of Lead. Moreover they make by Art, *Cinabrio*, *Mercury* ſublimate, *Precipitate*, *Pſorico*, *Eſmalte*, *Eſcoria*, *Diaphryges*, *Cadmia*, *Pompholix*, *Spodos*, *Flor de Cobre*, *Sueſcama*, *Cardenillo*, *Vermicular*, *Stommoma*, *Herrumbre*, *Aſcul*, *Albayalde*, *Sandix*, *Ocbra*, *Greta*, *Purpurena*, and *Glaſs*.

Cinabrio is compounded of one part Sulphur, and two Parts Quickſilver, well boiled, and ſublimated together in glaſs Vials, or in earthen Veſſels that are glazed. Mercury ſublimate is compounded of half Quickſilver, half Copperas, ground together extraordinary fine, and ſprinkling a little ſtrong Vinegar upon it as it grinds, that it may the better incorporate, then ſublimate it in glaſs Vials as aforeſaid; it is alſo made with Allum, and many times they mingle a little Salt with it.

Diſſolve Quickſilver in *Aqua-fortis*, then ſet it upon a gentle Fire, and let the Humidity evaporate, and the Quickſilver will remain hard as a Stone, then grind it very ſmall, and ſet it again upon the Fire in a Crucible, (or Veſſel of Copper, if it can be gotten) and keep ſtirring the Quickſilver, until it be of a very lively red Colour, and then take it off the Fire for Service, and this is called *Precipitate*.

Pſorico is made of two Parts of *Chalcitis*, and one of *Grita*, ground and mingled together with a little ſtrong Vinegar; ſet it in a Muckhil for forty Days together, then take it out, and in a broken piece of a Pot, toaſt it over the Fire till it be very red.

The beſt *Eſmalte* is made of Allum, Copperas, and Saltpetre; it is ſuſceptible of all Colours, as Glaſs is.

Eſcoria is that which worketh out of the Metal when it runs, and ſwims upon the top of it like Fat, which we call Droſs.

That which remains in the bottom of the Furnace, when they melt Copper is called *Diaphryges.*

Cadmia (although there be of it natural) is alſo that which ſticks to the Walls of the Furnaces, principally wherein Copper is melted, of which they call *Bodrite*, that which is like unto *Cobos*; and *Stracita*, that which is like unto Potſheard; and *Placite*, that which looks like Bark or Shavings.

Pompholix is a mealy Subſtance, and looks like Wool, as it ſticks to the Walls, but diſſolves as ſoon as one's Fingers touch it. It grows upon the Walls as they melt Metal. They vulgarly call it *Atutia*.

Spodo is very little different from the *Pompholix*, only that it is more impure. It is found upon the Walls where they refine Metal.

Flower of Copper is made by pouring cold Water upon the Plates of Copper, as they come red hot out of the Furnace, which with the Fume, raiſe up little ſmall Grains, which they ſweep off into a little iron Fireſhovel, and ſo preſerve it.

La Eſcama del Cobre, is that which falls off from the Metal when it is hammered and beaten, and that which in like Manner falls off from Iron is called *Stommoma*, although this *Greek* Name rather ſignifies Steel.

Cardenillo is made by ſtopping Vials of Vinegar with Stopples of Copper, and letting it ſtand ten or twelve Days before it is uſed.

If inſtead of Copper aforeſaid, they uſe Stopples of Iron, it makes *Herrumbre*.

Vermicular is very like to *Cardenillo*; take one Part of White-wine Vinegar, and two Parts of ſtinking Urine, and pour it into a Copper Baſon or Mortar, and ſtir it about with a Peſtle of the ſame, until it grow thick, then put a twenty-fourth Part of Salt and Allum to it, ſet it in the Sun, until it coagulate and dry, and it will turn into the Form of little Worms, from whence it derives the Name.

El Azul (or Blew) is made by covering a Veſſel of ſtrong Vinegar (wherein a little *Almojatre* hath been diſſolved) with fine Sheets of Quickſilvered *Plantada*, full of ſmall Holes, and putting it into a hot Muckhil, and after twenty Days ſtanding there, rake out the *Aſchul* for uſe.

If in the former Caſe one puts Lead over the Vinegar, it makes *Albayalde*.

Put *Albayalde* in a Spoon, or Iron Veſſel, upon kindled Embers, and ſtir it until it looks very red, and then it is *Sandix*.

Ochra is yellow, it is made of Lead burnt until it come to that Colour.

Greta is made in the refining of Gold and Silver, whereof hereafter.

Purpurina is of the Colour of Gold, but of little Endurance, and laſts not long. Take four or five Parts of Tin, and as much Quickſilver, one Part of *Almojatra*, and another of

Sulphur, and grind them, mingle them in a glaſs Viol, and diſtil them, and the Subſtance that remains in the Bottom is the *Purpurina.*

In the laſt Place comes the moſt curious Production of Art, and that is the making of Glaſs. Take two Parts of tranſparent Sand, or Powder of Stones, which diſſolve in the Fire; one Part of Nitre, or Saltpetre, or Salt of *Soſa* (which they call the Herb of Glaſs) clear and purify it with the Mixture of a little Powder of a Loadſtone.

Another Receipt. Take two Parts of Aſhes, and one of the Sand aforeſaid, with the Powder of Loadſtone, and give it a fitting Heat in the Furnace.

CHAP. XXXV.

Of the Colours of all Minerals generally.

THAT thoſe who want Experience may the more eaſily know the Minerals that come to their Hands, and that by their Eyeſight (the trueſt Informer of all the Senſes) they may know what they meet with in the Bottom of Mines, I ſhall reduce all Sorts of Minerals into Colours, as to a *Genius* moſt familiarly known; ſome Sorts of *Greta*, (or Fullers Earth) Allum, *Amianta*, the *Arabick* Stone, the *Meliti*, the *Gallatiti*, (or the Milk Stone) Alablaſter, the Diamond, Silver, Quickſilver, Tin, and Marble, are of white Colour;

la tierra Pingiti, Jeat, *Sori*, *Melanteria*, are black; of an Aſh Colour are the *Eritrian*, and the *Melian* Earth; of Blue is the Saphire, the *Ciano*, the Turky Stone, the *Lapis Laculo*, and *el Cibairo*; of green Colour is the Emerald, the *Praſma*, the *Chriſocola*, or *Atincar*, ſome Sort of *Greta*, and Vitriol, or Copperas: of the yellow Colour is Gold, the *Ochra*, the *Chriſopacio*, the *Chriſolite*, and Orpiment; of red the Ruby, the *Granatte*, the *Balax*, the Cornelian, the *Sandaraca*, Corral, *la Piedra*, *Seiſſile*, the *Hematite*, or Bloodſtone, Copper, *Minio*, (or Vermillion) the *Lemnian* Earth, and *Almagre*; of purple Colour is the *Jacint*, and *Amathiſt*; of a clear Blue the *Jaſper*, called *Boria*; of a greeniſh Blue the *Cardenillo*, and the *Armenian* Stone, or *Cibairo* are of this Colour; (and ſo the Painters call the Colour which they make of this ſtone, a verdured Blue) of a white inclining to a Red is the *Afrodeſiaca*; of a Red that is whitiſh, is the *Xanto*; between Black and Red is the *Batrachiti*; of a Black inclining to Purple is the *Alabandico*; of a yellowiſh White is the *Topaz*.

There be Minerals of any one ſingle Colour, either Black or White, or mixed together, as the Agates. The *Apſito* hath red Veins diſperſed upon a black Field, and contrarywiſe the *Naſomonite* hath black Veins upon a red Field. The *Helictrope* in his fine green Subſtance hath Veins of the pureſt Blood; and in Saphire, and *lapis Lazuli*, are ſeen very reſplendent Gold. Two Veins, one White, and the other Red, run quite through the Subſtance of the *Egitilla*.

The *Eupatalo* is of four Colours, namely, Blue, fiery Red, Vermillion, Pippin Colour. The *Orea* alſo is wont to be found of as many Colours; namely, Red, Green, White, and Black.

CHAP. XXXVI.

Of the Faculties or Virtues of Minerals.

I SHALL finiſh this Treatiſe with a brief Relation of the medicinal Virtues that are found in Minerals, more than what hath been already mentioned, that thoſe that poſſeſs them may know how to benefit by them when the Occaſion ſerves. Some Minerals work by their occult eſſential Properties, (or ſpecial Form) others by the Mediation of their elementary Qualities, contrary to thoſe of the Diſeaſe. Of the firſt Sort ſome are oppoſite unto Poiſon, and others to other Sorts of Infirmities; and of thoſe that reſiſt Poiſon ſome cure the Plague, as the Emerald, the *Lemnian*, and the *Armenian* earth; others are good againſt one Sort of Poiſon only, as the Saphire drunk inwardly is againſt the biting of Scorpions. Sulphur, Nitre, and Copperas are good egainſt the venemous Muſhrooms: Salt uſed plaiſterwiſe, is good againſt the biting of Vipers and Scorpions, drunk inwardly is good againſt the Poiſon of *Opium* and Toadſtools. Of thoſe that cure by occult Quality, ſome ſtop the Blood from paſſing to a particular Part of the Body, as the *Hematite*; others corroborate and fortify the Stomach, when they are hung upon it by help of a String going about the Neck, as doth the true Jaſper; others tied to the left Arm reſtrain Abortion, as doth the Eagle Stone, which the *Greeks* call *Ætites*, and if it be bound upon the left Muſcle, it produces the quite contrary Effect, as alſo doth the Jaſper; others purge groſs Humours, as doth the Leadſtone; others Melancholly, as the Stone *Armenia*, or *Cibairo*; others provoke to vomit, as doth the aforeſaid *Armenia*, *Chryſocola*, Copperas and *Precipitate*.

Amongſt thoſe that work by their elementary Qualities (although generally all Minerals are drying) ſome heat the Body, as do Allum, Copperas, *Chalchitis*, *Miſi*, *Sori*, *Melanteria* and *Cardenillo*; others cool it, as do the *Eritrian* Earth, *Stibium*, (or Antimony) *Albayalde* and *Greta*, or *Lithargirio*. Others with the ſecond Qualities which they poſſeſs, ſoften Hardneſs, as doth the Agate, becauſe it participates ſo much of the *Betune*; others contrarywiſe will harden ſoft Parts, as doth the hard Lead and *Eſtibium*: ſome open the Pores of the Skin, as Nitre and the Scum thereof: others ſhut the Pores, as doth the *Samian* Earth, and all other Earth that is ſlimy and tough. Some diſſolve Warts, and Biles, and Kernels in the Body, as the *Piedra*, *Molar*, and the *Marcaſita*; others heal Wounds, as the *Chalchitis*, the *Miſi*, and Allum: Others corrode the Fleſh, as doth the Powder of the Stone *Aſia*, and Copperas, and

Cardenillo: Some make the Fleſh putrify, as Quick-lime, Orpiment, *Sandaraca*, and *Chryſocola*. Mercury ſublimate, Orpiment, *Sandaraca*, and Quick-lime are Poiſon, becauſe they corrode and putrify the Bowels; ſo alſo is Morter, *Albayalde*, and *Talco* calcined, becauſe obſtructing the Paſſage of the Spirits, they choak one.

The END *of the Firſt* BOOK.

THE
SECOND BOOK
OF THE
Art of Metals,

Wherein is taught the Common Way
Of REFINING
SILVER
BY
QUICK-SILVER,
WITH
Some NEW RULES added for the
better Performance of the ſame.

Written in *Spaniſh*,
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By the Right Honourable
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THE SECOND BOOK OF THE Art of METALS.

CHAP. I.

That no Man ought to be employed to refine Metals, but he that hath been examined and licenſed by Authority.

THE abundance of Minerals, wherewith God hath enriched almoſt all the Provinces of this new World (ſerving himſelf thereof as a Medium, to other high Deſigns of his Divine Providence) hath been ſo great, that it is ſcarce poſſible to be believed. The Mountain and Imperial City of *Potoſi*, having already yielded between four and five hundred Millions of Pieces of Eight, a quantity ſufficient to make ſuch another Hill of Silver; it is hard to form a Conception equal unto ſo exorbitant a Heap of Riches: but the better to help our Imagination therein, know that, if the Ground were covered with Pieces of Eight, laid as cloſe to one another, as is poſſible, they would take up the Space of ſixty Leagues ſquare, allowing five and twenty Pieces of Eight to a *Vare* of *Spain* (a *Vare* of *Spain* is thirty-three *Engliſh* Inches) and five thouſand *Vares* to a *Spaniſh* League. This Glut of Riches, hath been the Reaſon why they have not applied the Care that was requiſite, to prevent loſs and waſte in the refining of Oar, which ſpeaking with Moderation, hath been the loſs of many Millions, both for want of giving it due Law, the Nature, and Difference whereof they did not underſtand, and ſo proceeded by Chance and without good Ground; neither knew they well what quantity of Plate the Oar would yield. And laſtly, they deſtroyed unneceſſarily abundance of Quickſilver, whereof hath been already conſumed in this Imperial City, more than 234600 Quintals; I know not whether this Neglect ſpeaks Greatneſs of Mind in the Inhabitants of this Kingdom, that they deſpiſe to pick up Crums, which nevertheleſs were ſufficient to ſatisfy the Hunger of many Kingdoms of the other World; or whether it condemns the Careleſsneſs of ſo wiſe and well governed a Commonwealth, that they have not uſed all poſſible Means to put a ſtop to ſo unneceſſary a Prodigality. The firſt and fundamental Remedy whereof, is in my Opinion, that the Metals be refined by one that underſtands the Art, and is authoriſed thereunto by publick Licence, after ſtrict Examination of his Sufficiency, which is required before the Admiſſion unto divers Callings in the Commonwealth, without compariſon of much leſs Importance than this is. The Maſters of refining Works have taken no Care at all in this Matter, becauſe how negligently ſoever they refine their own Oar, they loſe nothing, but have all the Silver, either in the Plates, or amongſt the Droſs: and that which they refine for others, yield more Profit to theſe Refiners, the worſe it is wrought, becauſe more remains with them in the Droſs; but both theſe are ill Reaſons to proceed upon, becauſe the making full Profit of their own, muſt coſt a double Labour, and the ill refining other Mens, redounds to a publick Prejudice.

CHAP. II.

What Quantities, and what kind of Knowledge a Refiner ought to have.

IT is a very great Truſt that is put into the Refiners, the whole Riches which this moſt proſperous Country produceth, being put into their Hands without Account, or any Obligation of the Quantity they are to return; their Word and Honeſty only, without Reply, or Appeal from their Sentence, is the only Security of the Truth, of what the Oar hath yielded; and it had need be a ſtrong Security, when the violent Incitation of private Intereſt is to deceive. He therefore that liveth continually amongſt theſe Occaſions, had need be well furniſhed with the Honour of a Chriſtian, leſt having his Fingers perpetually kneading in the Paſte, a good deal do not ſtick unto them; there ought to be a great deal of Circumſpection in chuſing this Officer, for no Miſchief that hinders the refining of Oar, or extravagant Conſumption, or loſs of Quickſilver, can occaſion ſo great Prejudice as a Refiner of a wicked Conſcience.

Neither yet is it alone ſufficient, that his Manners be good, if he want the knowledge neceſſary to the Art of Refining. He ought to know all Sorts of Metals, their Qualities and Differences, which of them are moſt proper for Quickſilver, and which for melting, if there be Conveniency for it. He ſhould know the Diſeaſes alſo that infect Metals, and the Way of clearing them; the Accidents of Quickſilver, and the ordinary Way of refining in great and in little; and in no caſe let him be admitted for a Refiner, that doth not well underſtand how to make the leſſer Enſay by the Fire, of Oar that is ground to Powder, before the Metal be incorporated together, that ſo he may know certainly how much Silver ought to be gotten out of that Oar; and he ſhould never give over making Trials, until he hath obtained it. The want of this one Care has coſt this Kingdom abundance of Money, and is of great Prejudice to it, even at this Day; two Experiments whereof I ſhall relate, which have paſſed through my Hands, that you may the better eſtimate the Importance of this Advice: A few Years ago, when I lived in the Province, of the *Lipes*, in a Pariſh which they call *Xauquegua*, a Miner had wrought a Vein, out of which he drew a Quantity of very rich Metal, although he knew it not; he enſayed it by Quickſilver, and found it to contain four or five Pieces of Eight the Quintal, and at that Rate refined it all by the great; at length they deſerted the Mine for being of little Profit: Afterwards an *Indian* carried me to the Place, I found Metal in the Moulds that were drawn out, and alſo in the Vein which had not been much wrought, I enſayed it by the Fire, and found it to contain 900 Pieces of Eight the Quintal;

tal, although by the ordinary Way of Quickſilver it yielded but four or five; I diſcovered this Vein to the Magiſtrates, calling it by the Name of *Nueſtra Senora de Begomia*; they built a Mill preſently near it, and abundance of Miners flocked thereupon, and have gotten thence a great quantity of Silver.

In the Mountain of *Santa Juana*, out of the Mine of *Berenguela de Pavages*, they got a Metal like unto *Sorochos*, which by the ordinary Enſay with Quickſilver, appeared ſcarce to have any Silver at all in it; whereupon the Miners utterly deſerted it; until a Prieſt, a Friend of mine, ſent me ſome Pieces thereof unto *Oruro*, which I enſayed, and found them to contain 60 Pieces of Eight the Quintal; by my advice he dug a great quantity of that Metal, being laughed at by the Neighbours whilſt he was at work to ſo little purpoſe (as they thought) but afterwards much more envied by them for the great Riches he had gotten.

CHAP. III.

Of the Knowledge of Metals, and the Differences there are of them.

IT is almoſt impoſſible to teach thoſe that have not been acquainted with Metals, how to know them by the Sight, becauſe there is ſo great Diverſity of them; that there is ſcarce any Stone in one Mine that reſembles Stones of the ſame Metal in another Mine; no nor oftentimes of the ſame Mine itſelf. Nevertheleſs the Miners reduce theſe Differences unto three general Heads, which the *Spaniards* call, 1. *Pacos*. 2. *Mulatos*. And, 3. *Negrillos*. *Paco* in the general Language of this Country, is as much as to ſay of a red Colour, and ſuch more or leſs are the Stones, which they call *Metal Paco*, although in *Berengula de Pacages*, they call the Green Metals of Copper by the ſame Name, which alſo in theſe Provinces they give to Metal of any Colour, in contra-diſtinction to Metals, that ſhine like Steel or Glaſs, and another Sort which they call *Negrillos*. *Mulatos* is a Colour between the *Pacos* and *Negrillos*; and in the Mines, Metal of that Colour is produced in the ſame Order; it is of a brown Colour, and ordinarily accompanied with ſome of the *Margagita*; there is leſs of this Metal, than of the two other Sorts. The *Negrillos* have been diſcovered by, and take their Name from their Colour, although all black Metals are not comprehended under that Name. *La Tacana* a rich Metal, and uſually black, although there be of it Grey, and Aſh-coloured, which they call *Lipta*, belongs to the Metals *Pacos*, as alſo doth the Lead (for ſo they call the Silver Oar) which oftentimes is Black, Grey, Aſh-coloured, Green, White, and Orange-tawny, which they call *Suco*; and this laſt Year in the Mountain of *Potoſi*, there was found of it, of a bright lively Cinnamon Colour, or very fine Vermilion, a thing which hath not been ſeen in any other Mine. The *roches* might conſtitute a fourth Order of Metals, but I agree with the Opinion of others, that would have them ranked under the Name of *Negrillos*, to which alſo belongs the *Roſicler*, the richeſt Metal that Nature hath produced in the Form of a Stone; it is ſhining and brittle, and the Powder of it beaten finer with any hard thing, is of the Colour of pure Blood, it is very like unto *Cinabrio*, or that Vermilion which is made of Quickſilver and Sulphur, which gives a good hint for the finding out of divers other greater Secrets. *Cochico* is alſo of the ſame Kind a very rich maſſy Metal, but neither ſo brittle nor ſpungy as the *Roſicler* is, but it is more full of Lead, and is not ſo eaſily beaten to Powder, nor gives ſo perfect a blood Colour.

Soroches, *Tacana*, *Polvorilla*, *Roſicler*, *Cochico*, and *Negrillos*, are diſtinguiſhed one from another, in the Manner following.

The *Soroches* are black, or Aſh-coloured, either ſhining, or without any Luſtre (which they call dead Oar of Lead) and commonly contains ſome Silver.

The *Tacana* is Silver Oar cloſe compacted, of a black Colour, without any ſhining at all.

Polvorilla is *Tacana*; not congealed, nor ſtony, but is rich in that Oar they call *Pacos*, but not ſo much in the *Negrillos*, by reaſon of the Mixture of Copper that it hath.

The *Roſicler* and *Cochico* is Silver Oar with that ſame Varniſh, which hides it's own proper Colour, and ſhines, whereby it differs from the *Tacana*. That which predominates in the *Negrillos*, is Copper, either actual, or elſe virtual in the Copperas, wherewith it abounds ; it always contains Silver more or leſs, and is uſually accompanied with the *Margagita*.

The black Metal which feels like Lead, and is ſmooth (which makes as it were Leaves of Trees or Feathers) contains a great deal of *Alcohol*, or Antimony (which in ſome Parts they call *Macacote*) and but little Silver. Thoſe *Negrillos* which have Luſtre like poliſhed Steel, or Looking-glaſs, and are therefore called *Eſpejado* and *Acerados*, are the richer the nearer they approach unto the *Roſicler* and *Cochico*.

CHAP. IV.

Of the ſorting of Oar, and the proper Manner of refining each of them.

THE Skill of extracting all the Silver out of any Oar, begins to be exerciſed in the picking and ſorting of the Oar together ; the want of Care in ſorting Oar from Stones, that have no Oar in them, as alſo the Oar of one Sort of Metal from another, hath occaſioned much damage ; the leaſt Inconvenience hath been in the Uſe of Quickſilver, a quantity whereof is loſt together with grinding, and other Charges about that which is no Metal ; the greater Inconvenience hath been, where there was Metal, the failing to get out all the Silver, becauſe they have jumbled together Oar of ſeveral Sorts, and uſed but one Manner of refining, whereas thoſe Metals require a different Way of handling and time. To Enſay that Metal by Quickſilver, that requires the Fire, is to deſtroy it; to put that Metal in the Furnace, which is not to run, is to endamage the Metal, and to get no Profit at all; and although the ſeveral Oars be properly aſſigned, ſome to the Quickſilver, and ſome to the Fire, yet they have their Differences of being eaſier or harder to be refined according as they concur, or differ in the Remedy, that is neceſſary to be uſed for that Purpoſe. The Oar, which they call *Pacos*, that ſhines or ſparkles not at all, is proper for Quickſilver. The *Tacana* alſo may be refined by Quickſilver, but becauſe it is ſo very rich Oar, leſt it ſhould not be clean extracted, but part of it remain in the Droſs, it is better to melt it in a Bath of Lead. That Oar which containing Silver in it, yet they call by the Name of Lead Oar if it be over groſs, will neither grind well, nor cleave faſt to the Quickſilver, and is beſt to be melted together with the *Tacana*.

The moſt proper Way of dealing with the Oar they call *Machado*, is the Hammer; the *Soroches* need the Fire, the *Roſicler* and *Cochico* are to be melted like the *Tacana*; the *Negrillos* require both Fire and Quickſilver, for they prepare all the Oar of that Kind by the Fire, for the Quickſilver by that Means collecting the Silver, either burnt, or boiled, as ſhall be ſhewed hereafter.

CHAP. V.

How to know the ill Qualities that infect the Oar, and how to purge them away.

OF various and very different Qualities are the Subſtances that Nature hath produced in the Veins that contain the Oars of Metals, whether they be Abortions, which the Covetouſneſs of Mankind occaſions by tearing the Oar out of the Bowels of the Earth before it's full time, which otherwiſe would come to be Metal in Perfection, or whether it be excrementious Superfluities of the Generation of all Sorts of Metals; they be uſually called Semi-Minerals, and are Salts, Allum, Copperas, Sulphur, Orpiment, Sandaraca, Antimony, or Alcohol, Brimſtone, both white and black, and *Margagita*.

Scarce any Oar is gotten that doth not participate of one or more of theſe ill Companions, all of them being hindrances to the extracting Silver out of the Oar, whether it be by the Fire or Quickſilver; thoſe that partake of Copperas, of which ſort are thoſe they call *Copaquiras*, are mortal Enemies of Quickſilver, which they conſume and ſcatter, and that ill Condition is heightned, if Salt be mingled with it, which makes it penetrate more violently, and ſuddenly; the learned *Raimundus* knew this Antipathy very well, and hath left it diſcovered to us in Writing; and thoſe that deal in Metals daily have it in their Hands, and yet take no notice of it; this is that, which eats up the Quickſilver, and diſſipates the Caxomes of Metal, and hath occaſioned ſo great an Expence of Metals, namely, Iron, Lead, Tin, and Lime. Whoſoever hath a mind to make Experiment hereof, let him mix a little Quickſilver with Copperas well ground, and Water, and he ſhall ſee in an inſtant all the Quickſilver diſſolved and loſt: eſpecially if he put a little Salt to the former Compoſition. This will be no wonder to thoſe that know *Mercury* to be Quickſilver, and that the great Change in it's Subſtance, is cauſed by Copperas and Salt, wherewith it is mingled, and then ſublimated in the heat of the Fire; this is the greateſt Poiſon to the Refination by Quickſilver; although ſometimes it is uſeful, and ſerves like Treacle to thoſe Sorts of Oar, which have uſe of it, as ſhall be ſhewed in it's Place hereafter.

This inconvenience is found out, and remedied, with very much eaſe; grind a little Oar, and put ſome fair Water to it, heat it, the more the better, ſtir it well, and then let it ſtand a while, then pour out the clear Water into another Veſſel, leaving the Sedement behind undiſturbed, prove it by the Taſte, and you ſhall well judge what Mixture it hath by it's dry or ſour Taſte; and whoſoever deſires an occular Demonſtration of this, let him ſet the aforeſaid Water upon a gentle Fire, ſimpering until the Moiſture be conſumed, and he ſhall ſee with his Eyes; in that which remains at the Bottom, either Allum or Copperas. Bathe the Oar in the Manner aboveſaid, ſo often as ſhall be neceſſary, until the Water, that comes from it be ſweet, and without Taſte, or that ſtirring it with a bright Piece of Iron, it doth not ſtain it with the Colour of Copper, and then that Oar is perfectly cleanſed and ſecure, not to hurt the Quickſilver, when it is put unto it.

Although Sulphur, Betune, and Antimony do oftentimes diſcover themſelves unto the Sight, yet a better Way of finding them out is by the Smell, which comes from the Oar, when it is well burnt in the Fire; but for fuller Satisfaction herein, they may be diſcovered and cleared from the Oar in the Manner following.

Grind the Oar ſomewhat groſs, and put it in an earthen Pipkin that is not glazed, that hath a great many ſmall Holes in the Bottom of it, and ſtop the Mouth of it cloſe, then fit a Veſſel of Water round about it, in ſuch Manner as they do when they clear the Pine Apples from Quickſilver, and put Fire under the ſame Baſon of Water, wherein all the Smoak that goes out of thoſe little Holes will ſettle, and there you ſhall ſee congealed and ſwimming upon the Top of the Water, the Sulphur, Antimony or Betune, each in his proper Form. When the Oar will ſmoak no longer, it is a certain ſign that it is clear of thoſe Impediments, which although they be not direct Enemies to Quickſilver in raw Oar, yet the Varniſh which they give to the Silver, hinders the Quickſilver from laying hold of it, and uniting it together; and by the Brittleneſs and Aſperity like Glaſs, which thoſe Oars have that participate of the Impediments aforeſaid, they cut and divide the Quickſilver when they are ſtirred together into ſmall white Pins Heads as it were, which the *Spaniards* call *Lis*. It is neceſſary to burn this Sort of Oar, although it be good to melt them firſt before they put them into the fierce Fire, becauſe without that Preparation the Silver will all be turned into Droſs.

The *Margagita* that is in Oar, diſcovers itſelf but too plainly to the Eye by it's Weight and ſharp glaſſy Quality; it divides the Quickſilver into ſmall *Lis*; when they ſtir them together, thoſe ill Qualities are taken away by the Fire, if you burn it therein untill it's gloſs and ſhining be gone, it doth moſt hurt unto that Oar which they melt, the abundance of Sulphur whereof it is compounded making a great Scum upon the Face of the Liquor, which much ſtifleth the Fundition.

CHAP. VI.

Of the grinding of the Oars of Metal.

THE grinding of Oar is a Preparation abſolutely neceſſary for the getting out of it the Silver, or Gold that it contains by Quickſilver, and the Fineneſs of the Meal is a principal Means of ſhortening the Work and clear Extraction of the Plate: one Fault amongſt many, which the Blockiſhneſs of this

Country has committed, hath been to make the Meal very groſs, or to leave many Lumps therein; there needs no great Pains to prove that the Quickſilver attracts or incorporates with itſelf that Silver which it immediately touches; ſo that the Metal which is in the middle of any Lump remains in the ſame Condition it came out of the Mine, and has more or leſs loſs in it, according to the Richneſs of the original Oar, and according to the Richneſs or Courſeneſs of the Meal. I have made divers Trials of grinding thoſe Lumps over again, and find that in them remains, when leaſt, the ſixth Part of what is in the Oar when it is firſt taken out of the Mine, which is very conſiderable in a whole Years Work, and incredible in the great Quantity of Metals that have been already gotten. *Agricola* after having taught the Way of grinding and ſifting of Metals, which they now practiſe in the Mills, teaches a Way how to reduce it to extraordinary fine Flower in a kind of Horſe-Mill, with Stones like Mill Stones: He thought this Pains to be neceſſary, although to an End different from that refining which we now practiſe, wherein it is clearly and indiſpenſably neceſſary. I learned the Manner of doing this from one that had gotten a great deal of Money by grinding the Lumps over again, although he did not take out all the Plate, becauſe he ground them in an ordinary Mill, whoſe Hammers could not beat it ſo ſmall as it ought to be, for the Lumps either ſlipped away from under the Hammer, or being uneven one defended the other from the Stroke; to have good Sieves,

and

and Care in lifting them up is of great Importance to this Matter, but not a full Remedy, after the waſhing of the Oar, eſpecially if it were of rich Metal is the beſt gathering up of Lumps to regrind. If they burn the Lumps, they will yield more Flour, becauſe ſome of the Lumps will calcine and be ſmoother, and others will ſwell and grow more ſpungy, whereby the Blow of the Hammer will have better Effect upon them. I do uſe another Way of Preparation by boiling, as ſhall be ſhewed hereafter, which I do hold more proper to be uſed in all Refination by Quickſilver; put the Oar ground and ſearſed into a Skillet in like Manner (as if it were already incorporated with Quickſilver, and ready for waſhing) then pour a ſufficient Quantity of Water upon it, ſtirring it with a Ladle or Hand-Mill, whereby all the fine will ſwim at top, and the groſs and ill ground will ſink to the bottom; take away the fine with a Ladle, put it in the melting Pot and boil it, grind the groſſer Part again in a Mill or a Morter, until it become all Meal; if I deſire to make a Xoves of the fine Sort after the ordinary Manner of refining, I muſt mingle ſome pure Sand therewith, that it may ſwell and want the Inconveniences which that kind of Oar uſeth to be accompanied withall.

CHAP. VII.

Touching the burning of Oar.

THE burning of Oar is uſeful for two Purpoſes, *viz.* 1. That it may grind the better. 2. That it may be in better Diſpoſition for the Quickſilver to lay hold of, and incorporate itſelf with the Silver that is in it. The Reaſon of the firſt is plain, and Experience ſhews the latter; ſince they order all the Negrillos or blacker Oar in that Manner, but generally don't underſtand the Reaſon thereof. And certainly in all the Art of Refining, nothing is practiſed ſo much by Gueſs or Chance, and without knowing the Ground of it, as this is. Refiners will ſay, they burn the Oar to clear it of ill Qualities, not apprehending that thence it will follow that by Fire enough they ſhould quite cleanſe and purify it, whereas the contrary is found by Experience; and that according as they burn it more, the worſe conditioned is the Oar, and needs the Help of ſome other material to prevent that all the Silver and Quickſilver too, that is in it, be not loſt.

There is but one Enemy naturally oppoſite unto Quickſilver (as hath been ſaid already) and that is the Copperas, and the Fire is not only uſeleſs for the vanquiſhing that, but on the contrary it multiplies and encreaſes it;

and

and if the Oar have no Copperas in it when it is put into the Fire, the Fire will beget and produce it, as may eaſily be ſeen by Experiment. In the burning of Negrillos (or black Oar) in which the Fire encreaſes the Copperas ſo much, that it is neceſſary to uſe other Materials in the burning of it to repair that Damage, although if they had throughly underſtood this Matter, they might have cheaper and eaſier done it, by waſhing the Oar (as I have ſaid before) until it was cleared of all the Copperas; the Ignorance of which Remedy hath been the Occaſion of great Waſte and Loſs.

Other Diſeaſes of Oar do not directly injure the Quickſilver, only by the Varniſh and glaſſy Quality which they give, they hinder the Plate and Quickſilver from incorporating and making a Maſs together; and therefore the Rule in this Caſe is to burn the Oar ſo long until it change Colour and loſe the Luſtre and Sparkling that it had. To know the Oar that of Neceſſity muſt be burnt (if it be to be refined by Quickſilver) the Luſtre and Shining aforeſad is a certain Sign. The Fire will not prejudice that Oar they call Pacos, and if it have any Mixture of the aforeſaid Impediments, it muſt of neceſſity be burnt.

CHAP. VIII.

Touching the Damage that reſults from the burning of Oar.

MEN having hitherto proceeded by Chance as it were, and without certain Knowledge of the Quantity of Silver contained in a Piece of Oar have judged him the beſt Refiner that has gotten moſt Silver by one Operation, leaving it doubtful whether any more or no were to be gotten out of the Oar, eſpecially in the Negrillos and Oars that cannot be excuſed from burning. This Doubt has been greater, there being leſs Certainty here where there ought to be much the greater; and from hence Men have found no leſs Inconvenience by miſtaking on the one Hand, than on the other; wherefore this Manner of Preparation hath been eſteemed as dangerous as profitable. With Skill and Curioſity one may obſerve many Wonders of Nature in the burning of Oar, the Parts of Iron and Brimſtone, which commonly accompany the Oar, when they come to the Fire are converted into Vitriol or green Copperas; this afterwards is turned into fine Copper; again, the Copper calcined, diſſolves in Water like Salt, the which ſtrained and evaporated by a gentle Heat, coagulates into another kind of Vitriol, or blue Copperas, like unto that which they call the Sone *Lipes*, and is of admirable Virtue for the turning of almoſt all Metals into Copper; the Purity of Silver itſelf does not excuſe it from being ſubject to ſuch a Metamorphoſis; for if the Oar have in it any Allum, Copperas, Saltpetre, or Nitre, by the Help of the Fire they will calcine the Silver ſo, that it will diſſolve in Water, and not be laid hold on by Quickſilver without uſing ſome new Artifice; and even Salt alone as it grows incorporated in the Oar, or mingled with it in the Fire is capable of producing the ſame Effect as ſhall appear evidently in the following Experiments.

CHAP. IX.

Experiments which prove the Damage by the burning of Oar if they be not known and remedied.

GRIND a Piece of Oar that has Copper or Iron in it, and by the Direction of the Fifth Chapter of this Book, try if there be any Copperas in it, and if there be, clear the Oar of it by waſhing of it, and after it is dry burn it well, and put it into Water again, and you ſhall ſee much Copperas anew produced by the Fire; the Refiners daily do this with their Hands, although they take no

Notice of it; and although this Experiment be ſufficient to ſatisfy every body, yet for greater Confirmation of this Secret to grind Oar of Copper or Iron, and melt it into thin Plates, and grind ſome Sulphur, and in a Crucible or earthen Pot unglazed, put a Lare of that Sulphur, and upon that lay one of the Plates, and proceed in that Order as far as you think fit, ſtop the Mouth of it well, that it give no Vent; and after it is dry, put it between red hot Coals in ſuch Manner as they encompaſs it round about, but do not touch it; after the Crucible is ſufficiently hot, put the Fire nearer to it, and at laſt make the Fire fierce; but not ſo much as to melt the Plates; then take it out, and the Plates will look black and be brittle, grind them very fine, and put the fourth Part of their Weight of beaten Sulphur, together with them into a Piece of broken Pot or earthen Baſon upon Embers, heat them ſo as you heat an Enſay of the black Oar, ſtirring them continually until the Sulphur have left ſmoaking, and the oftener you repeat this the better; laſt of all, being well beaten and hot, or elſe the Water hot, and after a little time boil the Water, and if it colours bright Iron of a Copper Colour, that the Water evaporate by a gentle Fire, until it begins to be covered with a kind of Cream, then take it off and ſet it a cooling, and it will congeal into moſt beautiful tranſparent Copperas, green if the Plates were of Iron, or blue if the Plates were of Copper.

Diſſolve this Copperas, or Stone *Lipis* in Water, and put Steel or Iron to it, and it turns into moſt pure Copper, ſmooth, and ſoft as Gold after it is new melted. If one melt Lead or Tin, and pour it in ſmall Drops upon the Face of that Water, the whole Superficies will be turned into Copper, and the oftner it is repeated, the greater Quantity of the Lead will be transformed until no Lead remain.

Tin is very eaſily turned into Braſs. I was the firſt which in the Province of the *Lipis* found out and publiſhed theſe Secrets. Alſo Silver is turned into Copper, if it be made very fine, and with much Salt (an Experiment which ought to be as highly eſteemed by the Refiners, as the turning Copper into Silver). *Aqua fortis* is a common Thing, if it were not, it's Vertue would be held miraculous; it turns Silver into Water, and calcines it into Duſt; it is made of Copperas or Allum and Saltpetre. The Spirits that fly from any of theſe Subſtances, when Oar that contains them is caſt into the Furnace, works the ſame Effects with beaten Brick and Salt, eſpecially of the Rock is made a Cement, wherewith they ſeparate Silver from Gold; theſe two attract the Silver to themſelves, and with the Heat of the Fire only calcine it; in the burning of Oar they have the ſame Effect; the Silver being calcined in either of the aforeſaid Manners if it be put into Water, diſſolves in it like Salt, and the Water looks white as Milk, and will ſpot one's Hands or Nails if you touch it; notable Signs of *Aqua fortis* in Silver, whereunto Refiners ought to have great Regard, that it deſtroy not their Silver; theſe Inconveniences there are in the burning of Metals, beſides another which anon ſhall be diſcovered, and though the proper Way of avoiding them is caſting or melting the Oar which renders uſeful, not only that Metal which is precious, but alſo the baſer Sort, as ſhall be ſhewn in it's Place, nevertheleſs becauſe all Places do not afford Conveniences for melting down Oar, nor all Oars contain Metals rich enough to pay the Coſt, let the aforeſaid Inconveniences when they happen, be remedied according to the Rules which ſhall be ſet down hereafter, although it be impoſſible to prepare Oar without burning, ſo as to yield that Quantity of Plate it did by Quickſilver, as ſhall be ſhewn where the Refination by boiling is treated of.

CHAP. X.

Whether the Oar ought to be burnt in the Stone or in the Meal.

THEY uſe to burn Oar in the Stone or in the Meal; and burning it in the Meal, they better underſtand the Nature of the Oar, for taking Care to ſtir it well about, and mix it equally in the Furnace, taking out a ſmall Quantity, and putting Quickſilver and Salt thereunto in a ſhort Space of Time, by the Diſpoſition of the Quickſilver you ſhall quickly know what the Oar is, whether it begin to grow like Lead or no, and whether the Lead be groſs or fine, or whether there be need of more Materials or no, or whether to continue, or ſtop the burning of it; according as every Refiner by his own Experience hath found to ſucceed beſt with it out of that Oar which is burnt in the Stone, cannot be choſen this Equality, becauſe the Force of the Fire cannot be equally communicated to Stones in a divers Situation and of different Bigneſs; for it is clear that the ſmall Stones are ſooner heated than the greater, and thoſe that are in the Centre of the Furnace, ſooner than thoſe that touch the Sides; but this Manner of burning is ſubject to leaſt damage, beſides that it facilitates the grinding of the Oar.

It is a great Error to burn Oar already ground by Reverberation, becauſe the Fierceneſs of the Fire burns the Sulphur or Betun ~~which it contains, and ſuffer it not to diſcharge~~ itſelf by little and little, but obligeth it to mingle itſelf with the Silver, and altogether to turn it into Droſs; moreover the Force of the Flame raiſes up the ſettled Parts of the Silver when they ſtir the Oar, and turning it into Smoak, blows it out of the Furnace. The moſt ſecure Way of burning Oar already ground, is to do it by a Toſtadillo (or preſerving Pan) made in the Faſhion of a Furnace, as ſhall be directed hereafter, and becauſe the Meal is wont by the Fire to gather into little Lumps, or elſe to grow ſpungy and groſs, (it is convenient to grind it over again,) before it be incorporated; the beſt Way of all has been ſaid were to burn it in the Stone; becauſe it facilitates and ſaves a great Part of the grinding, and avoids the Inconvenience of the fine Silver flying away in the Smoak, and where the Oar is incorporated in hard Pebble and Flint, which are very untractable Stones, it is neceſſary to burn them. Other Sorts of Oar ought not to be burnt alone, but in Meal with the Mixture which ſhall be preſcribed according to the ill Qualities wherewith they are affected.

CHAP. XI.

Of Materials to be mixed with Oar, when they burn it.

IT is no extraordinary, but a common Thing for Iron to be engendered in the Gold and Silver Oar, and the Oar that is ſo affected is moſt difficult for burning or fundition either; it may be diſcovered by the Slowneſs of the Heat's Penetration into it, and alſo by a Loadſtone, paſſing it over the Oar, after it is well burnt, and ground, which will ſnatch up the Iron, if there be any, and more or leſs of it, according to the Quantity mixed with the Oar. This Kind of Oar after it is ground, ought to be mixed with Sulphur, or which is better with the Meal of Oar that hath Sulphur, or Antimony in it, and in ſuch Proportion as the Quantity of Iron in the Oar requires;

requires: when they are mingled, heat them upon the Toſtadillo until that taking out ſome of the Meal, and enſaying it according to Cuſtom, the Oar is found to be well conditioned. Sulphur is the Deſtruction of all Metals, Gold only excepted; it hurts Tin leſs than other Metals, and Iron moſt of all, and that is the Reaſon why the Sulphur and Iron combating with, and deſtroying each other in the Furnace, the Silver is left alone by it's ſelf. In like Manner is Oar cured that contains Sulphur or Antimony, being mingled and burnt with the Oar, or Droſs of Iron after it is well ground.

That Oar which contains Orpiment, or Sandaraca, ought to be burnt with Soroches, which is Oar of Lead and Sulphur; that which contains Betune black or white, muſt be burnt with Droſs of Iron, and Powder of white Stones, whereof they make Lime: Beſides, what hath been already ſaid, the Diſeaſes of Oar may be known by putting a little of it ground ſomewhat groſs upon a red hot Plate of Iron, obſerving well what Fume it makes, which if it be white or black, participates of Betunes of that Colour; if it were yellow, of Orpiment; if red, of Sandaraca; if it be yellow in the Middle, and green on the Outſides, of Sulphur; and likewiſe the Earth that is drawn out of the Mines, together with the Oar, will oftentimes ſend forth Fumes of the like Kind of Colours.

CHAP. XII.

What the Refiner muſt do before he incorporates the Caxon.

THE Refiner thoroughly underſtanding what has been ſaid before, the Oar being well ground and cearſed with that Curioſity and Circumſpection which is neceſſary (ſo that it need not be picked) before he doth go about to incorporate the Caxon, and before he burns the Meal, if there were need thereof, let him ſet apart three or four Pound of the Flower well mingled, and ſtirring it together again afreſh, take a ſmall Quantity, and make two Enſays thereof by melting in ſuch Manner, as ſhall be ſhewed hereafter; whereby he ſhall certainly know what Silver the Caxon contains, and how much he may expect to get out of it. Laying down this Ground, that the Oar is of that they call *Pacos*, and needs not burning, nor contains Copperas, nor Coppaquiras, take out ſome in the Manner aboveſaid, and Enſay a Pound of it by Quickſilver, but firſt pour upon the Oar a good deal of fair Water, more than is ordinarily neceſſary, and let it ſtand awhile, and if there ariſe a Scum, or Cream, that is groſs, or oily, ſcum it off, and let that Water run out, and repeat the ſame with freſh Water, ſo often, until no ſuch Scum ariſe, then take out ſo much Water as is ſuperfluous, and put Salt and Quickſilver to it, and without any other Material proceed in repeating, to caſt in thoſe too, marking well the Operation of the Quickſilver, whether by accident it meets with more Quickſilver; whether it turns little or much to Lead, whether it diſſolves or remains entire; if it faſtens upon the Oar without the Help of any Material, it is a ſign that the Oar do that tract it to itſelf: Repeat the Operation ſo, until you find that the Force of the Silver and the Repitition doth waſte the Quickſilver, which if it do the Work is excellent, and will produce the Silver in duſt as ſmall as Pin-duſt, which muſt be gotten together by ſearſing, and the Remainder, which is mingled with Quickſilver, muſt be gotten by waſhing, and ſo you ſhall have all that the Oar contained, agreeable to the Experiment, which was made by melting. The Oar of *Berenguela de Pacages* is of the Quality aforementioned; a great deal whereof was ſpoiled at firſt, by working it with Materials, ſuppoſing it impoſſible there ſhould be Oar, which did not ſtand in need thereof; now adays they refine with only Salt and Quickſilver, and get the ſame Quantity of Silver, as they did by melting, which is all that the Oar contains; this Oar is called *Cobrico*, if the Eſſay doth ſhew Lead, for ſo they call it, when the Quickſilver loſes it's own bright Colour, and looks like Lead, then other Materials are requiſite to cleanſe it, that it may the better take hold of, and gather the Silver together; thoſe Materials that have this Virtue are Iron diſſolved, Lead or Tin, and Lime ſlacked, or unſlacked for ſome Reſemblance it hath to Metal; any Oar may be refined with the Help of any one of theſe Materials, although that ſeems to be beſt, which is neareſt of kindred to the Mixture of the Oar. If the Duſt of the Silver, and Colour of the Quickſilver, be dusky and blackiſh, then Iron is moſt proper for it, for that which looks like Lead, Lead itſelf is beſt to that which is clear; Tin is the beſt for Quickſilver that looks as if it were guilt and hath Copper in it; Lime is the beſt. That Material which is moſt convenient, they throw in by little and little at a time, by Meaſure and Weight, until the Quickſilver look clear, and lay hold on the Silver, and by this they make the Account by the great, how much Materials they are to put into a Caxon or Cheſt, according to the Number of Quintals it contains.

If the Quickſilver be changed into white Powder or Aſhes, and often paſſing it again through the Oar, do not make it finer, it proceeds from the Weight and Solidity of the Oar, the proper Accidents of thoſe they call Soroches and Magagitas, and thoſe other Oars that ſparkle and have need of burning, as have been ſaid before. Hard Stones that have no Silver in them, cauſe the ſame Accidents in Quickſilver, wherefore looking upon it, reduced to white Powder as aforeſaid, if you do not diſcern either black Oar or Margagita amongſt it, there was no Silver contained in that Oar which was enſaid, and is good for nothing.

If in the leſſer Enſay, the Quickſilver be bright and entire, and falls to work, laying hold on the Silver, there is no need of uſing any other Material; all Enſays are made with a very little Quickſilver, that there may be room to uſe any other Materials, if there be Occaſion for it, if not, that more Quickſilver may be added, and ſo the work of Refining performed with greater Brevity and Security, as ſhall be ſhewed hereafter; and let not the Refiner ceaſe making Experiments, until the leſſer Enſay which he makes by Quickſilver, correſpond with that which he makes by melting, and let him proceed reſpectively in the greater refining of the Caxones.

CHAP. XIII.

Continuing the Rules of the laſt Chapter, touching Oar that has need of burning.

IF the Oar have need of burning, as hath been ſaid before, and the Enſays by melting made, and the Refiner aſſured of the Quantity of Plate the Oar contains, let him burn it, obſerving the Rules of what he is to mix with it according to the Bigneſs of the Work, and the Convenience he hath to perform it in, but in no Caſe let him burn any Oar with Salt; beſides that it helps to calcine the Silver, it gives a ſtronger force to thoſe ill Fumes which are in the Oar to penetrate into and ſpoil the Silver. One cannot well tell the ſet Number of Hours, wherein one ought to let Oar continue in the Fire, but the ſure Rule to know when the Oar is well conditioned, is by enſaying ſome of the burnt Meal; and if the Quickſilver remain intire and clear, and Silver ſticking about it like driven Snow, then it is burnt enough, and the Fire continued, will certainly produce this Effect if the Oar be mingled with due Materials, and in a juſt Quantity; in order to which, as alſo in the Oars they call Pacos, let them make leſſer Enſays to know what Quantity of Materials are to be put into the Furnace with every Quintal of Oar, but becauſe theſe Enſays are ſeldom made as they ſhould be, let the following Rules be obſerved.

When the Oar in the Furnace leaves ſmelling ill, it is a Sign that it has diſcharged itſelf of all the Sulphur and Antimony that is in it; when that Oar charged with Betune, and at the firſt coming into the Furnace, throwing out a thick and black Smoak by Degrees, ſends forth a thinner and whiter Fume; it ſhews that Inconvenience to be cured.

When Oar changes Colour, loſing the ſparkling that it had, and of *Negrillo* becoming *Paco*, it is a certain Sign that it is well diſpoſed for the Quickſilver, although in this there be exceeding great Latitude.

That Oar which contains Copperas, if it be to be put in the Fire, muſt firſt be cleanſed by waſhing in Meal, as hath been ſaid, otherwiſe when it comes in the Furnace, it will become very red as may be ſeen if one burn Copperas alone in the Fire.

When Enſaying a little of the Meal burnt, the Quickſilver begins to look like Lead, it is a Sign that by the Heat of the Fire, the Copper, or Iron which the Métal contains (together with the Mixture of Sulphur) the Antimony or Margagita are turning into Copperas, and that the faſter, the longer the Fire continues.

Take a Pound of the Meal out of the Furnace, whilſt it is hot put it into a Veſſel, and pour Water upon it three or four Fingers deep, then ſtir it a while, and let it ſettle, then if the Water turn white, or ſtain ones Nails, or change the Colour of the Tags of Points put thereinto, it is a Sign that the Silver calcineth and diſſolves in the Water like Salt; ſave this Water in a glaſs Veſſel, and pour more upon the Oar two or three times, or as often as is neceſſary, till it do not turn white; and all the Silver that was calcined, will be gotten out of the Oar; let the Water evaporate by a gentle Fire, and all the Plate will ſettle in the Bottom, and become fit for uſe by melting.

If the Water into which the hot Oar was put, gives no Signs of the Silver being calcined, dip poliſhed Iron into it, and if it come out coloured like Copper, there is much Copperas in the Metal; wherefore waſh the Metal in the Manner as hath been taught, until it be cleared of the Copperas, and change not the Colour of Iron; ſave the Waters of this Operation, for they are very uſeful in the refining Oar that have need of it, and if you ſhould take out and melt the Sedement that is in the Bottom of that Water, fine Copper will be produced thereby, or Silver if any ſuch have been calcined.

Enſay a little of the Oar, ſo diſpoſed, by Quickſilver, as hath been ſaid of the Oars Pacos, until by Experience you have found out the Way how to refine in greater Quantity, ſo that you may get as much Silver as you know that Oar contains by Enſays of melting in the Fire. Let nobody condemn theſe for tedious and unneceſſary Curioſities, for there is nothing more profitable and important in theſe Matters, nor leſs commonly known; and by the Care and Pains of a few Days, the Refiner will be acquainted with the Sorts and Qualities of Oar that come to his Hand, and know how to proceed with them without wearying himſelf with making Enſays; but for all that hath been ſaid, the Oar never comes to be perfectly refined, until the Silver little or much that it contained be purified and whitened in the Meal, and it is not impoſſible to put it in that Eſtate. Since the Oars Pacos of Lead may be reduced thereunto only by burning, and the Negrillos and others alſo that have Sulphur in them which ſtains and blacks the Silver, although it muſt be a long time in the Fire before it comes to this, and both one Sort of Oar and the other muſt have Boilings and Liquors often paſſed thro' them, which do cleanſe and whiten the Silver, ſuch as Millo, Allum, Salt and others, the Oar being in this Condition, needs no other Material but Quickſilver, which in leſs than four Days time will gather together all the Silver, and be very little conſumed itſelf, becauſe the ſhort time of Operation, the Abſence of ill Qualities, and the ſeldom times repaſſing it through the Oar, will not regrind, or diſperſe it to Powder, which is the principal Reaſon of the loſs of Quickſilver, as ſhall be ſhewed hereafter.

CHAP. XIV.

Of the Nature of Quickſilver.

DEferring until another Occaſion, which it may be in due time will offer itſelf to treat purpoſely of Quickſilver, and ſome Excrements thereof, of no leſs Profit than Curioſity; for the preſent, I ſhall only ſay with that Phœnix of Science in his intellective Art, which all do follow, who treat of the hidden Philoſophy of Metals, that Nature hath made this body of ſo uniform a Subſtance, and of Parts ſo perfectly united, that even the Fire, his greateſt Enemy, as the Vulgar think, is not powerful enough by dividing to corrupt, and deſtroy it as it viſibly doth all other Metals and Bodies in the World, except Gold and Silver. The Quickſilver retains it's whole intire Subſtance in the Fire, if it be prepared on Purpoſe for it, which many Perſons know how to do, or elſe all of it will fly quite away in the Form of Smoak, and meeting with any body that refreſhes it; it will condenſe therein in it's own proper Form without being diminiſhed one Hair, either in Weight or Quantity; neither alſo do the ill Qualities that are ordinarily found in Oar corrupt Quickſilver in Veins wherein it is begotten, nor in the Cheſts wherein they refine, for although Copperas do diſſolve it in that Manner that it ſeems to be conſumed, and being ſublimated in Copperas, and common Salt, it is transformed and turned into that which we call *Mercury*, that one would think it were totally deſtroyed and turned into another Species, yet it is not ſo, but all thoſe Accidents have their Remedies, and it is neither impoſſible nor very difficult to quicken it again, and unite it, and in it's Place I ſhall ſhew how this is to be done.

CHAP. XV.

Touching the Cauſes and Differences of that which is called Lis.

QUickſilver diſſolved, and divided into very ſubtile Parts, is commonly called by the Refiners *Lis*, which ſhews itſelf like an Eye-brow, in the Matter *Purunnia* when the Oar is enſayed; and from it the experienced Refiners take their Indication of the Quality of the Oar and Condition of the Caxomes; it is cauſed by the often paſſing of it through the Oar (a Thing inexcuſable in the ordinary Way of Refining) although it hath no ill Quality at all, but if it hath Copperas in it, it will grind the Quickſilver in great Extremity, as hath been ſaid. If Quickſilver be without any foreign Impreſſion upon it, and be diſſolved into *Lis*, which is white, it is called *Lis* of Quickſilver; *Lis* of other Materials, is called that which is made by Quickſilver of Tin or Lead; and *Lis* of Silver is the fine and ſubtile Parts of Silver, made by the repaſſing of the Quickſilver through the Oar, but not as yet joined or incorporated with it; which when it is, they call by the Name of *Pella* (which ſignifies a Ball or Pellet). Quickſilver is ſuſceptible of divers Colours, which appears in the *Liſes* according to the different Matter which accompanies that Silver Oar into which it is thrown; theſe Colours are reduced into three *Genuſes* as it were, which comprehend under them ſeveral other Species.

Thoſe three are
Cleer.
Lead Coloured.
Spotted.

The Quickſilver looks cleer, either when the Oar hath no Silver at all in it, or when the Silver it contains is fine without any Alloy or Mixture; in that Caſe the Quickſilver will attract, and cloath itſelf with the Duſt of fine Silver, without loſing the Livelineſs of it's Colour; which when it changeth, they call it leaden, for it's likeneſs unto the Colour of that Metal, although it always is accompanied with Signs that the Oar contains Silver, unleſs it be that the Lead, for ſo they call it, proceed from falſe Principles, and thoſe have a manifeſt Cauſe, although little taken Notice of, as well as the other Proceedings in refining, which hitherunto have been governed by Chance. It is Copperas alone (the mortal Enemy of Quickſilver) which gives it the falſe Colour of Lead, in like Manner as it doth to other Metals the Colour of Copper; the other Lead Colour is a certain Sign of Silver, becauſe ordinarily it is made in raw Oar, that is mixed with divers other bad Things, the which attracting to itſelf the Quickſilver; the Quickſilver lays hold of, and carries away both the Metal, and alſo it's bad Companions, who give it that ſtrange Colour; this is the true Ground of what is treated of in the 12th Chapt. of this Book, and the Reaſon of that Aſſertion, that the black or obſcure *Lis*, or Colour of Quickſilver proceeds from Oar that is mixed with Iron; if the Quickſilver have a deep lead Colour, then it hath Lead itſelf in it's Company; if it be ſomething more clear, then it hath Tin; and if it look as if it were guilt a little, Copper. Whether the *Lis* be of Quickſilver, Silver, or of other Materials is eaſy to be diſcerned; for the *Lis* of Quickſilver is very fine, white, but wanting Quickneſs, and when it falls together with the Water into the Tray, it doth not run up and down, but remains as if it ſtuck to the Bottom, and if you rub it with your Finger, it will unite into Lumps of Quickſilver. The *Lis* of Silver ſhines, and is like Pinduſt, or finer according to the Richneſs of the Oar, when they let the Water out from the Oar; it runs about the Bottom of the Tray, and if you rub it with your Finger, it will gather together into Pellets; the *Lis* of other Materials is as it were a middle Thing between the other two, and being reduced into a Body by rubbing it with one's Finger, it unites itſelf with the touched Quickſilver.

CHAP. XVI.

Whether it be fitting at firſt to put in all the Quickſilver, and the other Materials at once or no?

THE Oar being in good Diſpoſition, and the Refiner by the foregoing Rules being aſſured how much Silver the Caxon contains, and what Proportion of Quickſilver and other Materials is neceſſary to be put in, ſo that when it comes to be waſhed, it may yield three Parts of Silver Pellets, and one of Quickſilver. It may be doubted whether all the Quickſilver and Materials aforeſaid, ſhould be put into the incorporating Veſſel at once, or no: For the moſt Part, if not all the Artiſts of this Country did uſe to do it at once; until about twenty Years ago. When I came to live in the Province of the *Lipes*, I perſuaded them to the contrary, according to Rules, which I had learned in ſuch like Operations, out of *Raimundus Lullus*; which do evidently agree with the ordinary Courſe of Nature, that brings to Perfection all things by a ſlow and gentle Growth, and not ſuddenly nor violently. A very little Fire is ſufficient to burn the whole World, if the combuſtible Matter were put into it by little and little, proportionable to the Force of the Fire; but if all that Matter, or an over-great Proportion of it ſhould be laid upon the Fire at once, it would choak it, and put it out. The natural Heat of Animals is ſubject to the ſame Inconvenience, and the ſame happens proportionally unto the Cheſts of Metals: Beſides that by Experience it is found, that the extraordinary Cold of much Quickſilver, doth accidentally bind up the Oar, and hinder the Refine, as on the contrary any Heat haſtens it. Moreover, if becauſe they have judged ill of the Remedy to be put into the Cheſt, the Caxon deſpair, and the Quickſilver diſſolve, the Remedy will be the eaſier, the leſs looſe the Caxon. And if there be need of uſing Tin or Lead, which cannot be applied without Quickſilver, that will be added with leſs Danger, the Quickſilver being in already. The ſame Damage or greater follows, when they exceed in the Quantity of Materials they put into the Oar which hath need thereof, becauſe it dulls and deadens the Quickſilver, ſo that it will lay hold on no Silver at all, and can very hardly ever be reduced into that Condition it ought to be. After many Days ſpent in repaſſing the Quickſilver, and dreſſing of the Oar, let the Caxon be incorporated and waſhed with a third Part of Quickſilver at the moſt; and at firſt put in half the Tin or Lead, that is requiſite to be ſpent, for ſo the Quickſilver will the better lay hold of the Plate, and draw it out preſently before the Materials are conſumed, which they call *Aplomar*: Whereby will be avoided the Danger of the dry Plate, which, like Froth, ſwims upon the Water that comes out, and is the Occaſion of much Miſchief. If the Caxon ſtand in need thereof, proceed to put in more Quickſilver, and other Materials, always diminiſhing the Quantities proportionally in ſuch manner, that it may go dry and not wet; for ſo there will be no Occaſion for much *Lis*, and the Pellets themſelves will ſerve to get out the reſt of the Silver, whereby the Refining will be ſooneſt and moſt ſecurely performed. If it be needful to refine with Lime, the Rule already preſcribed for Materials will not ſerve, but the Lime muſt be put in all at once; and with it repaſs the Caxon very well two or three Days before you put in the Quickſilver, taking eſpecial Care that you do not put in too much of it; becauſe it is the great Hinderance that the Quickſilver doth not lay hold of the greater Plate, and that is more hard to correct than other Materials.

CHAP. XVII.

Of the repeated paſſing the Quickſilver through the Oar and the Effects thereof.

THE chief and principal End of letting it ſoak through, is to divide the Quickſilver into ſeveral Bodies, that it may every where lay hold of the Plate; alſo with that Motion it is heated, and better diſpoſed for the Work: And laſt of all by that Frication, the Plate is cleanſed and purified (which is that they call waſting the Materials:) All of them, Things moſt neceſſary and important, although they cauſe an unpardonable Damage, that hath been the loſs of many Millions in the waſting and conſumption of Quickſilver: For the Repaſſings have been the Foundation of this Inconvenience, by ſqueezing the Quickſilver through the groſſer and finer Parts of the Meal into ſuch little Atoms (which they call *Lis*) that ſcarce have Weight or Dimenſion; which when they waſh, the Caxon doth not fall down into the Tub at the Bottom; but being over-drowned and mingled with the Lamas or Mud of the Meal, it ſtays and is caſt away with them. This Inconvenience may be prevented by two Cautions; the one is, that the firſt and ſecond Day after the incorporating of the Meal of Oar in the Caxon, they give not above two gentle Repaſſings, ſo that the Quickſilver may be divided, but not into too ſmall Parcels; becauſe before it hath gotten a good body of Silver, it is ſubject to part itſelf over finely. The Second is as abovesaid, that they put in the other Materials dry, and not wetted with Quickſilver, putting them in by little and little when it is moſt in the Proportion, one Part of Quickſilver to two of Pellets. Let nobody deceive themſelves, for although the Meal in the Caxon contain other Materials ſufficient, if it be much bathed with Quickſilver, that it ſhall be ſecured from the former Inconvenience; yet contrarywiſe it will rather be ſubject to a greater Prejudice, for of Neceſſity the Repaſſings will make *Lis*, and if it happen by ſome Accident, as it very well may, that the Materials be quite conſumed; inſtead of the *Lis* made of them will remain only *Lis* of Quickſilver. In the *Lis* of Plate there is not that Danger, that by the often Repaſſings the Silver, ſhould be waſted or conſumed; rather it is thereby better refined, and better embraceth and uniteth itſelf with the Quickſilver.

CHAP. XVIII.

Of divers Accidents, which happen in the Way of Refining by Quickſilver, and their Remedies.

IN the Progreſs of this Kind of Refining, divers Accidents are met withal in the Caxons (or Cheſts full of Oar ground to be refined;) all which are diſcovered only by the Quickſilver, which as in a Glaſs repreſents the good, or ill Diſpoſition of the Metals, which in themſelves, by Reaſon of the Fineneſs of the Meal into which they are ground, and a Mixture of Earth in the Oar, cannot be diſcerned.

If the Quickſilver be very much charged above what it ought with Materials, that is to ſay, Lead, Tin, Iron, or Lime (which the *Spaniards* call Quickſilver *Tocado*) it will not appear round but flatter'd, or rather prolonged like little Worms; and if you ſtir it about the Tray without Water, it will make Drops with little Tails, and ſtick to the Sides of the Tray. And when it is of this Condition, it is a Sign that it is killed, and it's Virtue obſtructed from laying hold of the Silver. This Evil is remedied by much Repaſſing, not without great Coſt and Expence of time: The quickeſt and moſt efficacious Remedy is Copperas, or the Water thereof, which I have ſhewed how to make and to keep in the Thirteenth Chapter of this Book: Put it into the Caxones at the ſame time as you do the Quickſilver, and other refining Materials more or leſs, according as there is Occaſion, and you ſhall inſtantly ſee the Effect of it. The Reaſon whereof is plain, for (as hath been ſaid) Copperas diſſolved in Water converts the baſer Metals into true Copper; ſo that the Quality of Gold which they had before, and wherewith they choaked the Quickſilver, being turned into Heat (the Property of Copper) it is the Cauſe of reviving the Quickſilver: From hence is grounded the Practice of putting Copper ground ſmall into the Caxon, which is found very profitable for the Purpoſe aforeſaid: Hence alſo it comes to paſs, that all Oar of Copper, although it be rich, is not proper to clear Quickſilver with, or to be uſed in the Refining to make it Aplomar, unleſs it have a great deal of Verdigreaſe or Copperas. The ſame Account may be given of the Virtue that is found in thoſe they call Magiſtrates, which they uſe in the Refining to qualify the Caxones with Heat, and to make them Aplomar: Which Effect is produced from the burnt Copperas that is in it, as may be ſeen in their Compoſition, which for better Satisfaction I ſhall here ſet down.

Burn Oar or Copper, and grind it well; then with an equal Quantity of Salt knead it into a body together, and having made it into Loaves, burn it again.

Others do mingle but one Part of Salt, with two Parts of Copper Oar, which they make up into a body and burn; and to one Quintal of that beaten to Powder, they add half a Pound of Filings of Latin.

Another Magiſtral is made of Lamas.

Relabes and Salt, an equal Portion of either ſoundly burnt together.

Another is made of that Oar wherewith they refine the Relabes and Salt put together in equal Portions.

Another Sort may be made of Copper Oar, Relabes, Meal of that Oar which is to be refined, droſs of Iron and Salt, all put together in equal Portions and burnt in Loaves.

Another is made of three Parts of the Lamas burnt, and one Part of Salt. Every one inventing ſuch like Compoſitions or Proportions, according to his own Fanſy and Experience; the Foundation of all theſe Magiſtrales being the Copperas which the Fire produces in them, as may be ſeen and ſeparated from them, by any who ſhall pleaſe to go about it, according to the Rules that have been already delivered: Which ſeems to confirm that which *Pliny* ſays, treating of Copper, namely, that it is begotten of Stones burnt.

Theſe Magiſtrales are to be uſed with the ſame carefulneſs as hath been already ſaid of the Materials; namely they are to be made trial of before the incorporating of the Caxon, that by theſe leſſer Enſays it may be known what Proportion is fit to be put into the Caxon, according to the Number of Quintals it ſhall contain; for if the Proportion do exceed, another great Inconvenience will be produced thereby, namely that which follows,

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CHAP. XIX.

In proſecution of the Chapter foregoing.

AN Accident contrary to that mentioned in the former Chapter, and an Occaſion of great waſte of Quickſilver, is of the Colour of Lead; that is to ſay, when it is affected with no other Material Inconvenience, but only that of Diſcoloration; and the Damage is the greater, if the diſcolouring hath proceeded from Copperas, and that there be much Quickſilver divided, and running looſe about. Quickſilver ſqueezed out of the Lumps, is very round and lively; if it be divided, the Parts of it, although never ſo ſmall, do not run into a cylindrical Figure, but into a Spherical. This Miſchief is cured by the contrary Materials, which as hath been ſaid before, cleave unto the Quickſilver; nevertheleſs the Medicine, which by it's particular Qualities, Attraction, and natural Sympathy, cures this Evil, is Iron; which re-unites the Quickſilver, and gathers it together into a Body after it was diſſolved, corrupted, and, in a Manner, turned into another Subſtance by the Copperas: Which ſhall be treated of more at large hereafter, when we ſpeak of waſhing the Caxons.

No certain Rule can be given, what Quantity of Materials to put into the Caxons, that

have

have failed in the Operation; becauſe the Miſchief and the Cauſes thereof are not always the ſame. But this general Rule muſt be obſerved, that they do not repaſs the Caxon with Quickſilver, till they have firſt enſayed a ſmall Quantity thereof, and thereby have underſtood what is neceſſary. After that, let them take a third or a fourth Part of the Caxon, and mingle that with the whole Proportion of the Materials, and ſtir it well together, till it be very well mixed, and incorporated one with another; then mix this with the reſt of the Caxon, ſtir them very well together; for after this Manner the Medicine will be beſt, and with moſt equality diſtributed in the Caxon: Eſpecially if the Medicine to be put in, be very ſmall in Quantity. Have a care to uſe the Means that is requiſite to avoid falling into the firſt Inconvenience of overcharging the Quickſilver, and remedy the ſecond Miſchief with all poſſible Speed; becauſe otherwiſe the Copperas will transform the Quickſilver in ſuch Manner, as if it were quite eaten up and conſumed. When enſaying the Caxon, the Quickſilver is found in the Bottom of the *Purummia* Veſſel, divided in ſmall Grains not run together in a Lump, it is a Sign the Refination is imperfect, and that ſome little hairyneſs, or criſping encompaſſeth the Pellets of Quickſilver, and hinders them uniting. The Want of Materials is commonly the Cauſe of this, or elſe the over-much Allay of other Metals, which as well a the Plate attracts the Quickſilver itſelf. Repaſſing, the Relabillo burnt, by Reaſon of it's ſharp cutting Quality, is profitable to cleanſe the

Quickſilver. Some put in Aſhes, but the moſt proper and natural Remedy for it, is that which they call Millo or Allum, which makes the Silver white, and is very ordinarily to be had in great abundance amongſt the Mines here at *Potoſi*; and in *Guaico de Santiago* there is a Spring that runs continually with this Allum Water.

When the Caxon hath not been repaſſed equally, or not ſerved with as much Quickſilver as is neceſſary, or in ſome Places doth not unite itſelf with other Parts of the Quickſilver, that had gotten Plate already, the Cauſe thereof is what they call dry Plate: In Enſays you ſhall ſee it ſwim upon the Relabes criſped like Froth, and if it be not ſkimmed off, and ſaved before the cleanſing the Caxon, it will ſwim at the top, and run away with the Lamas to the great Detriment of him that owns the Oar. If the Quickſilver be dry, having nevertheleſs Materials ſufficient with it, it is no Inconvenience at all, becauſe it will unite one with another the better, or elſe that Part which the Materials poſſeſſed, being waſted away, the other moiſt Parts remain in the Quickſilver to unite itſelf with the reſt of the Pellets. That dry Plate which wants Materials, cannot ſafely be gathered together by looſe Quickſilver, until the Caxon be ready for cleanſing; the proper Remedy for this is to repaſs the Caxon with Pellets of Silver, not over ſmall, ſo ſhall the dry Plate be collected together, and the greateſt Part of the *Lis* alſo, if there were any there.

CHAP. XX.

How to know whether or no the Caxon be ready for waſhing.

THERE can no certain time be prefixed, wherein one is obliged to waſh the Caxons. It's Maturity is haſtened by frequent Repaſſings by the outward Heat of the Air, and the inward Heat of the Copper or Copperas, and other Things of that kind of Virtue, and ſuch as clear and purify the Silver; a principal Cauſe whereof is the burning of Metals. On the contrary, the Work of Refining is prolonged and ſlackened by fewer Repaſſings, if the Air be Cold or Froſt, if the Caxon be over foul, that the Quickſilver loſes it's clearneſs in paſſing through: But letting paſs theſe, and other Accidents, let us come to the Point of gathering out the clear Silver mixed with Quickſilver, leaving the Earth behind, which is called waſhing the Caxon, whereunto no ſmall Experience is neceſſary: For if the Caxon be not ripe for waſhing, that Plate which the Quickſilver hath not laid hold on, is likely to be utterly loſt, or if it be not, it muſt be ground over again, ſo that at leaſt one loſes much time and Labour, and Silver too in the Repaſſings, beſides other Hazards.

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The Rules hitherto delivered for the Diſcovery of the Diſpoſition of the Caxon are ſubject to very great Error; ſuch as it's appearing ſo well to Sight as if there were need of no more Quickſilver; to find the *Lis* of the Plate all gathered together and finiſhed, and that of the Quickſilver beginning to come; the Subſtance of the Plate, and Quickſilver being clear, and gilded as it were with other Signs, all of which do not ſecure the Judgment from being erroneous, becauſe theſe may be produced by other Accidents beſides the Maturity of the Caxon. The only ſure and infallible Sign is to ſee whether the Quickſilver hath gotten all the Plate, which it ought to do according to the Proportion ſhewed by the leſſer Enſay of Fire, which was made at the beginning, and if it hath not arrived to that, although it hath many more good Signs than hath been already mentioned, waſh not the Caxon; but take more ſmall Enſays thereof, whereby you ſhall eaſily prove what Plate it contains, and what Remedy is neceſſary to bring it to full Perfection: Which when it is attained, and the refined Subſtance alone contains the aforeſaid Proportion of Quickſilver and Pellet, ſtrow ſome Quickſilver looſe upon it, and therewith gently repaſs it two or three times in ſuch Manner as it may go into the Copper better bathed, in the Proportion of three Parts Pellet, and two of Quickſilver: Or at leaſt two of Pellet and one of Quickſilver. Then gather up ſome of the *Lis* that remains, and put it to the dry Plate, and to the whole Maſs of Pellet, whereby they will be more weighty, and ſink better to the Bottom of the Caldron, and will riſe and waſteleſs in the boiling. Throw Quickſilver alſo looſe into the Caldron (which they call a Bath;) when it begins to be liquid, incorporate therewith that which the Caxon contained, and it will help to unite it the better; and the more Quickſilver there was, the fewer Inequalities like Oyſter ſhells will be produced.

CHAP. XXI.

That the waſhing of the Caxons cauſeth the loſs and waſte of Quickſilver.

ALL the Inconveniences that are and have been found in the Waſte of Quickſilver, which they term either Loſs or Conſumption of it, are cauſed by the waſhing the Caxons: Until then nothing hath been loſt; however, one may be deceived in judging by the View even on Occaſions, that have ſometimes happened and may happen again; that they find neither Quickſilver nor Pellet of incorporated Metal in the Caxon. For Accidents alone as hath been ſaid, cannot alter the Quickſilver ſo as to corrupt and deſtroy it's Subſtance; in the Caxon it is howſoever more or leſs diſpoſed to get out imperceptibly with the Water or with the Lamas. The immediate Cauſe of this Miſchief, is when the Quickſilver is made over thin without body or weight, as it were; ſo that it hath nothing to ſink it to the bottom of the Caldron; and with the ſtirring the Caxon when they waſh it, it mixeth itſelf with the Dregs and Dirt, and goes along with them, and there wants more or leſs of the Quickſilver which they put in at firſt, according to their better or worſe ſtirring the Caxon and Quantity of *Lis*. It hath been a great Error in thoſe, that becauſe for ſo many Years the beſt Refiners in theſe Kingdoms have waſted at the leaſt ſo much Quickſilver, as they have gotten Plate, therefore the Quickſilver is really and truly conſumed in the Operation, not animadverting the Evidence to the contrary, which continually paſſeth through their Hands; namely in the Lamas and Relics of the Caxon where the Quickſilver hath oftentimes ſtaid behind, accompanied with a conſiderable Quantity of Plate: Which the Owners of Oar have experimented to their great Damage, and the Buyers and Refiners of the Relics of the Caxon to their great Profit and Advantage. Others ſpeaking philoſophically ſay, the Cauſe of the Conſumption of the Quickſilver proceeds from the Contention and Combat, which it hath with contrary Qualities before it can lay hold on the Plate; and that thereby it is debilitated and conſumed. Theſe Men ſay ſomething to the Purpoſe, if they could demonſtrate the contrary Qualities that are between Quickſilver and other Metals, between whom there is rather a great Sympathy and Agreement, Quickſilver being the principal whereof all other Metals are made, and alſo of the Minerals that ordinarily do accompany them; but if theſe Men cannot prove the Cauſe, neither will the Effect which they ſuppoſe, namely the Deſtruction of Quickſilver follow: And there is certain Experience to the contrary, and hereafter ſhall be ſhewed a Way how to recover all the Quickſilver, even out of the Caxon, that is moſt ſpoiled in Operation, and ſo moſt difficult to do it in.

CHAP. XXII.

The true Cauſes of the Loſs of Quickſilver, and their Remedies.

THE Repaſſings are rhe remote Cauſe of waſting of the Quickſilver, which is thereby ſtrained and divided into very ſmall Parts which they call *Lis:* And although into whatſoever Oar, Earth or Sand, you throw Quickſilver, and repaſs it, you ſhall find the Effect aforeſaid, yet it is moſt of all experimented in thoſe Oars which are called Soroches; which by their Weight and glaſſy Quality, do more eaſily cut aſunder and divide the Quickſilver into minute Parts.

Copperas is of it's own Nature a violent Cauſe of extenuating the Quickſilver, as hath been often ſaid; and hath been the Cauſe of the waſte of the greateſt Part of the Quickſilver that hath been deſtroyed. There be other Cauſes, which accompany and aſſiſt the two former in working this ill Effect: One is the Salt, which they uſe in refining, and wherewith they waſh the Caxons, which every body knows thickens Water; whereby not only the ſmall *Lis* of Quickſilver, but alſo heavier things ſwim and cannot ſink to the bottom.

The Lamas which is mingled with the Water, and troubles it in the Caldron, thickens it, and doth yet more reſiſt the ſinking of the Quickſilver which ſtays and is thrown away together with it.

Laſtly, the Motion of the Inſtrument wherewith they ſtir the Caxon when they waſh it by condenſing the Force of the Cauſes aforeſaid, hinders the *Lis* from ſinking, and croudeth it up to the top. The ordinary Repaſſings in this Way of Refining cannot be wholly excuſed in this Matter; but if the Rules already taught be carefully obſerved, the Damage will be the leſs. Likewiſe already hath been ſhewed the Way to clear Oar from the Copperas, and to clear the Margagita's from their heavy and glaſſy Qualities. Salt may be gotten out of the Caxons two ſeveral Ways, and preſerved for Uſe to the ſaving of many Ducats a Year, now commonly ſpent in that Commodity. Put the Oar into Caxons made ſmooth and round on the Inſide without Corners or Angles as is often uſed; let them ſtand a little ſloping, only ſo much as is neceſſary, that all the Water may run to one Port of it; where there muſt be a Hole for it to run out at in convenient Seaſon, but ordinarily kept ſtopp'd. When the Caxon is ready for waſhing, fill it with abundance of Water, opening and ſtirring about the Oar with the Hove, that the Water may penetrate through it the better: And having done ſo a pretty while, open the Hole, and let the Water out into a Veſſel provided on Purpoſe to receive it; where it will either congeal into Salt, or remain in Liquor as it is, and will be ſerviceable for the Operation of other Caxons. Repeat this two or three times until the Water that comes out doth not taſte brackiſh. If the Caxon was to have been waſhed in three Caldrons, waſh it in ſix, whereby the Water will come out twice as clear, and with very little Mud or Sediment.

The Peſtle wherewith they ſtir the Caxon, muſt not be uſed always in the ſame Hand, becauſe the Circles going conſtantly parallel, the ſmall Parts of the Quickſilver, and the dry Plate go along together with them; and never encounter one another to unite themſelves into a bigger Body that they may ſink to the Bottom. Wherefore after five or ſix turns with the right Hand, take as many more with the left, and ſo proceed; and becauſe this cannot ſo conveniently be done in the ordinary waſhing Places, put into the Caldron a thing like a broad Peel, which oppoſite to the Courſe and Motion of the Peſtle may diſturb the March of the Quickſilver and dry Plate, and cauſe all the Content of the Veſſel to meet and unite; excepting that which is at the Bottom, whereof there is no Neceſſity, becauſe of the Bath which it is to ſuffer. Cover the Veſſel with Plates of Copper, or Iron Quickſilvered, to which Side ſoever of the Veſſel the *Lis* comes: It may ſtick thereunto, when the Caxon is waſhed; the *Lis* is eaſily gotten together, by ſweeping the Sides of the Veſſel with a Piece of Shoe Leather, a Piece of a Hat, or a Piece of Cloath.

CHAP. XXIII.

To make the Pine Apples, and to clear them of the Quickſilver.

HAVING taken the Plate and Quickſilver together out of the Caldron, and ſtraining it through two coarſe Clothes wetted, to make them the thicker; having beaten it alſo with a Battledoor to ſqueeze as much Quickſilver through the Clothes as is poſſible: Make Pine Apples of the dry Pellets in Moulds fitted for that Purpoſe; which are called Pine Apples from their Similitude to that Fruit by reaſcn of their pyramidal Figure: And of thoſe Pines that have been reaſonably well ſtrained, the fifth Part will be Silver, ſo that one hundred Pound of Pellers will produce twenty Pound Weight of Silver. The Pines that are made of richer Oar ariſe to leſs Profit than thoſe that are made of poorer, becauſe the Plate in the richer Oar is more coarſe and ſpungy, than that which is contained in the poorer. In the ſtraining of the Quickſilver though never ſo carefully, ſome ſmall Parts of the Silver will go along with it, and the more in Quantity by how much the more Moiſture there was in the Pellets when they began.

began to ſtrain them: The like whereof is ſeen in Water mixed with Clay, which although it be ſtrained with never ſo much Care, will not look clear and pure, but muddy and troubled, by reaſon of it's Mixture with the Dirt; and the greater Quantity of Water there was, the more Dirt ſtrains through along with it; but letting it ſtand quietly a while, it will ſettle and gather itſelf together, and leave the Water clear. In like Manner, in the Veſſels wherein they preſerve the Quickſilver after they have done refining, and made the Pine Apples, after a few Days the Pellets of Silver will ſettle and gather into a body together. In the refining Work of St *Catharines* in the *Lipes* out of the Veſſel, wherein they kept their Quickſilver, I ſaw as much Plate gotten of the Kind aforeſaid, as would have made a great Pine Apple.

If the Quickſilver be heated, it becomes thinner, and will carry away more Silver in the Straining; alſo when the Pellets are ſtrained, that are gotten by boiling, although it be done with very much Care, yet Plate will paſs along with the Quickſilver; and if you will let it ſtand a Days time to cool and ſettle, and ſtrain it again, you will get more Pellets of Silver.

The Loſs in clearing the Oar again from the Quickſilver hath been great and irrecoverable, as may be gueſſed from the Experiment thereof in this imperial City at this preſent, when the trading in Metals runs but low: And yet *communibus annis* above thirty thouſand Pieces of Eight are waſted by the Expence of Quickſilver. How vaſt a Sum then hath been ſpent by Quickſilver, in the many other very rich Mines belonging to this Kingdom. This Inconvenience hath proceeded from want of Care in ſeeing that the Canones and Caperucas (which are the Names of the Veſſels they uſe in the recovering the Quickſilver) be made of very good Stuff, and ſhut curiouſly cloſe in the Place where they join together. The Clay whereof uſually they are made is very ſpungy and full of Pores, ſo that the Water ſoaks through and ſweats out at them; then it is no Wonder that the Quick-ſilver attenuated by the Violence of the Fire (which widens the Pores of the Veſſel alſo) evaporates through the ſame, and is exhaled and loſt. To ſay that any Part of the Quickſilver is deſtroyed or periſheth by the Heat of the Fire is only the Imagination of thoſe that underſtand not the Uniformity of it's Subſtance, as hath been ſhewed before. Make the Caperucas and Canones of ſuch Stuff as you make the Crucibles, and that Inconvenience will ceaſe, and the Veſſels will laſt for ever (becauſe they are ſo mightily condenſed and reſiſt the Fire) unleſs ſome accidental Blow or Knock do break them. In that noble Town of St *Philippi* of *Auſtria*, *Oruro*, famous for Abundance of Mines both of Gold and Silver, on the Top of a little Hill which ſtands above the Church of the *Ranqueria*, there is a little Vein of white Earth, whereof they make Veſſels for Uſe, which after they are baked become ſo cloſe and firm that they are not inferior to the beſt *China*. I was the firſt that made trial and publiſhed the Uſefulneſs of it for the making of Crucibles with very good Succeſs to thoſe that had need of them. And I do not doubt but there is ſuch Kind of Earth about this City of *Potoſi*, where nothing hath been found wanting that any wiſe belonged to the obtaining or refining of that Abundance of Riches, which Nature hath beſtowed upon it: Although hitherunto much Buſineſs, and a ſhort Time of abode here, hath hindered me from finding of it out. But where ſuch Kind of Earth is wanting, mingle the Clay, whereof you make theſe Veſſels, the better with the Scum or Droſs of Iron ground very fine, and make it up and bake it very well; and there ſhall not be ſo much Quickſilver loſt in the Uſe of them as is by thoſe now in common Uſe. The Canones muſt be glaz'd on the Inſide, the Caperucas not; becauſe the violent Heat will melt the Glaſing, and make it run.

CHAP. XXIV.

Other ſafer Ways of clearing the Pine Apples from Quick-Silver.

THE beſt Veſſels for this Purpoſe are made of Iron or Copper beaten to the Thickneſs of a Piece of Eight, or ſomewhat thinner; and for more Security, that the Veſſels may the better endure the Fire, they cover the Copper Veſſel with a Coat of good earthen Ware on the outſide. Not many Years ago, ſome People began to uſe theſe Copper Veſſels caſed with earthen Ware, and left them off again, becauſe they underſtood not the Nature of them, nor how to uſe them. The like happened in the Province of the *Chickas*, which caſed their refining Veſſels as above ſaid, becauſe they heard that in their Neighbourhood in the *Lipes*, I was working after that Manner. The Cauſe of theſe Miſtakes ſhall be ſhewed in the Diſcourſe which follows.

The ſhorteſt, beſt, and moſt ſecure Way of clearing the Pine Apples from Quickſilver is in this Manner. Make a deep Veſſel of Iron wider at the Top than at the Bottom, containing more or leſs according to the Quantity of Metal intended to be cleared at one Time: Set it upon a Trevet of ſtrong earthen Ware, or of Iron caſed with Earth in a Furnace of ſufficient Bigneſs to put Wood or Coals under it, as Occaſion ſhall require at a Mouth made for that Purpoſe. The Reſt of that Furnace both the Top, Bottom, and Sides is to be very cloſe; excepting one little Hole at the Top where it ſhall be found moſt convenient to give Reſpiration. Diſpoſe the Veſſel aforeſaid in ſuch Manner as they do that which they call the Cannon in the ordinary Way of uſing Quickſilver; ſo that it may look out above the Top of the Furnace one large Finger's Breadth or two, that it may the better join with another Veſſel to be put a-top of it, which may ſerve inſtead of the Caperuca. Put the Pellet (or Mettle aforeſaid) well kneaded together in Cakes of what Form you pleaſe into the Veſſel, and leſt the Plate ſhould melt and ſtick to the Iron Veſſel, let it have a thin Coat on the Inſide of earthen Ware; or ſuch as Crucibles are made of. Cover this Veſſel with a large Limbeck Head made of hammer'd Iron, or Copper, or of very good earthen Ware well glaz'd; and out of it draw a long Pipe a little ſloping, the Cavity whereof in the narroweſt Place, namely the Extremity, let be no leſſer, than the Bigneſs of one's little Finger. Let the joining of the Limbeck with the Veſſel below it, be ſtopped very cloſe with Galt; then in a ſecure Place, that doth not feel the Heat of the Furnace, let there be placed a great Veſſel of Stone or of other Matter full of cold Water; whereinto let the Noſe of the Limbeck enter two Finger's Breadth. Blow up the Fire in the Furnace, from

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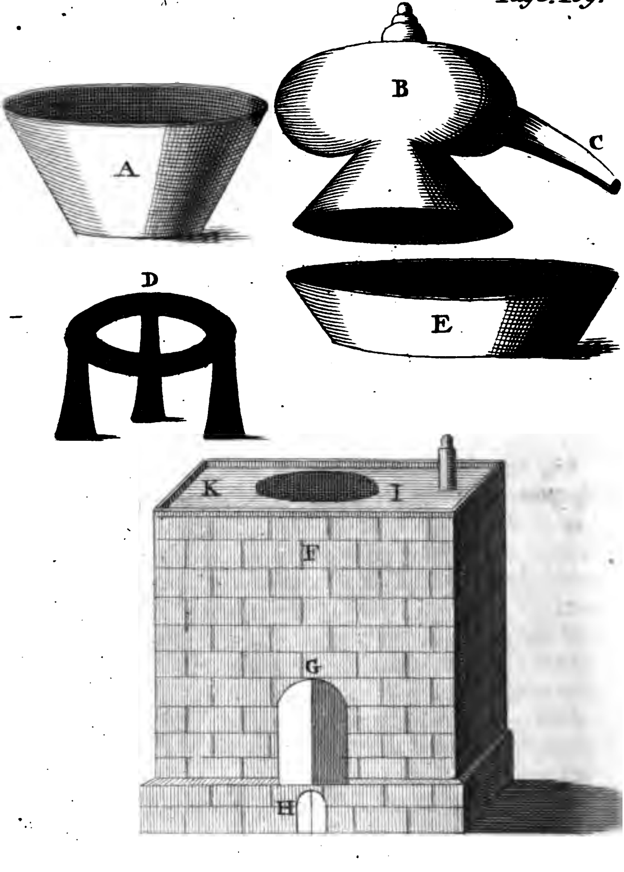

from which the Quickſilver flying in the Form of Vapours to the Top of the Limbeck, the Coolneſs thereof preſently reduceth it into a Body again, which runs down through the Noſe into the Veſſel of Water aforeſaid. The Limbeck ſhould now and then be cooled on the Outſide with wet Clothes, and the Water into which the Quickſilver falls as it becomes warm ſhould have more freſh Water added to it.

Here place the Cut.

A. The deep Veſſel of Iron, or Copper.
B. The Head of the Limbeck.
C. The Noſe of it.
D. A Trevet.
E. A Baſon or Veſſel of Water to receive the Quickſilver in.
F. The Furnace.
G. the Mouth of it.
H. The Hole to draw out the Aſhes at.
I. A Hole open at the Top of the Furnace, whereat the deep Iron Veſſel looks out a little, and is joined to the Limbeck.
K. Is a Chimney to let out Smoak, and give Reſpiration to the Fire.

The Trouble and Hazard of keeping them cloſe in the Joint with Clay or Galt, may be excuſed, by making the Place where they ſhut one upon the other a Handful and a half higher; or if to that Size of them, that is now in uſe, they put at the Bottom on the Outſide, and fill it two Fingers broad, ſo that the lower Veſſel may come up very cloſe upon it, and cannot enter further into it. A little lower than the Caperucas come, are placed the Candleſtick-Foot, as they call it, whereupon they ſet the Plate and the Pine-Apple. The Candleſtick-Foot comes up about four Fingers higher than the Mouth of the lower Veſſel, which they call the Cannon; in the which, on the one Side, four or ſix Fingers lower than the Fire uſed to be, enters in a ſmall Pipe of cold Water, at a Hole made for that Purpoſe in the Cannon, without diſturbing the Caperuca at all, becauſe it is not to go in ſtrait, but with a little Liberty. Over againſt this Hole there is ſuch another, out of which runs as much Water as enters in at the former, whereby the Cannon is always kept full, and the Water in good Temper to receive the Quickſilver without any Prejudice.

If one ſeparates the Quickſilver by the Limbeck, they may do the ſame thing, clapping a Ring of Copper of two Fingers breadth, and other two Fingers deep, to the Mouth of the lower Veſſel; ſo that the other Veſſel may eaſily be let in and out, wherein the Quickſilver is to be ſaved. Into this Circle the Limbeck muſt be fitted, and, to prevent it's being blown off with the Force of the Vapour of the Quickſilver, the Limbeck muſt be kept down with Weight on the Top of it, or tying it to ſome other fixed Thing; or making a Ring on the Top of the Limbeck, paſs a Bar of Iron through it, both Ends whereof afterwards remaining fixed in two Walls built on each Side of it for that Purpoſe.

The End of the Second Book of ALONSO BARBA'*s* Art of Metals.

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Mr *GABRIEL PLATTES.*

LONDON,
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TO THE
READER.

W*HEREAS diverſe Reaſons have joined together to move me to take in hand this Taſk, I will declare ſome few of thoſe that may give the beſt Satisfaction to the Reader, in this Manner following. Firſt, when I conſidered the great Number of Treaſure and Riches which lieth hidden in the Belly of the Earth, and doth no Good at all; and alſo the great Benefit which might accrue to diverſe Kingdoms and Countries, by ſetting People to Work, not only in the diſcovering them, but alſo in the ſeveral Operations about the Digging, Melting, and Refining of them; alſo when I* *conſidered that the moſt Part of the Mines hitherto diſcovered have come by mere Accident, I thought that I could not be better employed, than to give Rules and Directions for the ſame. For though it is not impoſſible, that if two Men be ſent to ſeek a Thing that is loſt, and one of them be hoodwink'd, and the other have the Uſe and Benefit of his Eyes, yet the Perſon hoodwink'd may caſually ſtumble upon it; nevertheleſs it is twenty to one that the other ſhould have found it before him. So in this Caſe, I dare hazard a Wager of twenty to one, that there will be more good Mines diſcovered within ſeven Years after the divulging of theſe Rules and Directions, than hath been in twenty-ſeven Years before. Alſo when I conſidered that many Minerals found out by Accident hath come to no Good, by reaſon of the Diſtance of Place from Refiners, and Men of Judgment and Experience; for that the Finders thereof were loath to come ſo far, and ſpend ſo much Money upon an Uncertainty, as the Trial thereof would require, I thought I could not do a better Deed, than to ſhew the Manner of ſuch Trials, in ſuch plain Manner, that every Man may try the ſame in his Ship, or Chimney Corner, with little Coſt and Labour.*

And the Truth of this I can witneſs by Experience; for when I was a Youth, and had no Skill in theſe Affairs, I happened upon a Mineral fair to ſee to, and could find no Man nearer than an hundred Miles which could inform me of the true Value thereof; whereupon, rather than to be at ſuch Charges as the Trial required, I ſuffered the ſame to be neglected.

And though that the Rules and Directions given in this Book be exquiſite, and give ſtrong Signs of Metals and Minerals, yet I would be loath that any Man ſhould be thereby animated to take in hand great Voyages, and conſume his Eſtate in the Purſuit of this Deſign, deeming them to be impoſſible ever to fail, but rather to make this a Part of his Buſineſs, when he ſhall come to ſuch Places as yield ſtrong Probabilities.

And ſo far I am from envying the former Ways in finding them by accident, that I have partly taken this Pains, that thoſe which ſhall hereafter be found by accident may not be neglected, as I conjecture, that many have been by my own formerly mentioned.

For I could wiſh that many Men had the like Fortune that one had, who in the climbing up of the great Mountain Potoſi, *in the*

Kingdom of Peru *in the* Weſt-Indies, *took hold of a young Tree to ſtay himſelf withal, and thereby plucked it up by the Roots, whereunto there did adhere good Silver Oar; which being tried, and found rich, hath ever ſince been wrought upon, and innumerable Treaſure and Riches have therehence been digged, to the Value of many hundred Millions of Pounds* Sterling.

Your hearty Well-wiſher,

G. P.

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A
DISCOVERY
Of all SORTS of
Mines, Minerals, &c.

CHAP. I.

Wherein is demonſtrated the natural Cauſe of the Generation and Production of Mountains and Metals; whereby the Seekers may obtain a good competent Meaſure of Knowledge to guide them where to ſeek for the other Eternal Signs.

SOLOMON ſaith, that *Hope deferred breaks the Heart; but the Deſire obtained, is a Tree of Life:* If Hope only deferred break the Heart, then Hope fruſtrated muſt needs break it a great deal more.

To the End therefore that our Hope may not be too frequently fruſtrated, I will firſt declare the Places where there is no Probability to find out Metals, and afterwards I will ſhew where there is ſtrong Probability: And then in the next Chapter I will ſhew how to go about the Work, to find out the ſtrong Signs which may rightly guide the Seekers to obtain their Deſire.

And firſt, there is no Probability that any Metals can be generated near unto the North and South Poles of the Globe, for thoſe can by no Means have any convenient Matrix for ſuch a Generation, being by all Probabilities nothing, but two Iſlands of Ice; for if they were any Thing elſe the Courſe of Nature muſt needs alter, and change, and run preſently out of Order.

For as there is in the burning Zones a continual Exhalation of Water, and rarifying of the ſame into Air: So there muſt needs be in the North and South a continual Condenſation of Air into Water to ſupply the ſame again, elſe the Motion cannot be perpetually circular.

Now whereas the North and South Parts, by Reaſon of their Coldneſs, cannot ſuffer the ſaid condenſed Meteors to deſcend in Form of Water, but in the Form of Snow, Hail, or ſome Subſtance of like Nature, which there cannot melt in the Superficies for Want of Heat, it is very probable that the new Accretion this Way produced, doth preſs down ſtill with it's Weight the ſaid Iſlands of Ice towards the Center, where the central Heat melteth it off continually, by which Means the ſpherical Form of both Earth and Water are perpetually preſerved.

And if any Man be of a contrary Opinion, I will not envy him; but as for my own Part, I will ſell my Intereſt and Hope of Metals in thoſe Places for a Farthing, although I had a Device that the Cold there could not prevent my ſeeking for them.

Alſo in Vallies and plain Champain Countries, there is no Hope to proſper in this Deſign, for the Womb of ſuch Earth is not apt for ſuch a Generation, the Reaſons whereof will preſently follow.

Now that we have left us no other Places to ſeek in but the rocky Mountains, I will ſpend the reſt of this Chapter in demonſtrating the natural Cauſe of the Generation of Rocks, Mountains, and Metals, and ſo proceed forward.

And firſt, I will ſet down the Opinion of others with their Confutation; and laſtly, the Confirmation of my own Opinion by irrefragable Demonſtration.

Some have thought that the mighty Creator made the vaſt, deformed, and craggy Rocks and Mountains in the Beginning. But this appeareth to be an Opinion, whereby great Diſhonour may reflect upon the Creator, who beſides his Omnipotent Power, doth continually make uſe of his admirable Wiſdom, and exquiſite Artifice in all his Works, and made nothing deformed or unfit for the uſe for which it was created: Now the Earth being ordained to bear Fruits for the Uſe of Man, and Rocks are not fit for that Purpoſe, it plainly appeareth that they came not by Accident.

Some others have thought that they came by Accident, but yet that they were produced by Accreation in Length of Time, even as Warts, Tumours, Wenns, and Excreſcences are engendred in the Superficies of Mens Bodies: And of this Opinion I myſelf was in my Minority, till ſuch Time as by practical Experience I found out a more probable Opinion.

Now for a plain Demonſtration, let this Experiment following be tried, and I make no Queſtion, but that it will ſatisfy every one that hath an inquiſitive Diſpoſition.

Let there be had a great Retort of Glaſs, and let the ſame be half filled with Brimſtone, Sea coal, and as many bituminous and ſulphurous ſubteraneal Subſtances as can be had: Then fill the Neck thereof half full with the moſt free Earth from Stones that can be found, but thruſt it not in too hard, then let it be luted, and ſet in an open Furnace to diſtil with a temperate Fire, which may only kindle the ſaid Subſtances, and if you work exquiſitely, you ſhall find the ſaid Earth petrefied, and turned into a Stone: you ſhall alſo find Cracks and Chinks in it, filled with the moſt tenacious, clammy, and viſcuous Parts of the ſaid Vapours, which aſcended from the ſubteraneal combuſtible Subſtances.

Whereby it appeareth that the ſame Thing is done by Nature, and that the Rocks and craggy Mountains are cauſed by the Vapours of bituminous and ſulphurous Subſtances kindled in the Bowels of the Earth, of which there be divers ſo well known, that they need not be here mentioned: Alſo it appeareth that the Veins of Metals are engendered in the Cracks and Crannies of the ſaid Mountains, out of the moſt clammy and glutenous part of the ſaid Vapours there adhering, where the Cold gave them leave to be congealed and condenſed.

Now concerning the Exaltation of the Mountains above the Vallies, it appeareth to come to paſs by the Water in former times, whoſe Property is to wear away by it's Motion the moſt looſe earth, and to leave the more firm Ground, and rocky places higheſt; but whether this was done by *Noah*'s Flood, or by the Sea in former Ages, is doubted. As for my Opinion, I refer the Reader to my Book formerly mentioned, and if any Man be in Doubt of this, let him take the Stone formerly made by Art, and place it ſo, that the Motion of the Water may work upon it, and you ſhall find it worn moſt in the looſeſt Places, and leaſt in the more firm compacted Places; thereby ſhewing the natural Cauſe of Mountains and Vallies. Alſo if a River ſhould be turned out of it's Courſe, and the Bottom thereof accurately conſidered upon, how the Water by it's Motion hath worn away the Earth moſt in the looſeſt Earth, and leaſt in that which is more firm, it doth evidently demonſtrate the natural Cauſe of Hills and Vallies, and the Unevenneſs of the Earth cauſed by the Motion of the Sea in former Ages.

CHAP. II.

Wherein is ſhewn the Signs of Mines and Minerals, with the Manner how to work to find the ſame.

WHEN we come to the rocky and craggy Mountains, the firſt thing we are to obſerve, is the Barrenneſs of them; for the more barren they are, the greater Probability there is that they contain rich Mines and Minerals.

The next Work is to find out the Springs of Water iſſuing out of the ſaid Mountains, and thoſe being found, a Quantity of the ſaid Water is to be boiled in a new clean Pipkin, to the Conſiſtency of thin Oyl, but not ſo thick as a Sirrup, and when it is almoſt cold, then to put in an Urinal, and to ſet it in the coldeſt Place that can be found for three Days, then to play the Phyſician, and to obſerve it exquiſitely what Reſidence it yieldeth: If nothing ſettle but a black Earth or Mudd, it is a Sign of Coals: if ſome Part thereof ſhoot into Ice, or a Subſtance like Ice or Vitriol, then to obſerve the Colour thereof; if it be green or blewiſh, it is an evident Sign of Copper; if whitiſh, then it may ſignify any other Metal without Exception.

The next Work is to go to the bare Rocks, and there to find out the Clifts, Cracks, and Crannies; this done, to go to the Top, or till you find ſome Graſs growing right upon the Top of the ſaid Crannies; and then to obſerve diligently the kind of that Graſs, and how it differeth from other Graſs, ordinarily growing in the ſame Mountain; not only in Form, but alſo in Colour, which Colour ſheweth the greateſt Difference in the Heat of Summer; for the ſubterraneal Vapours iſſuing out of the Orifice of Mines differ from thoſe which iſſue out of more ſolid Places of the Mountains.

The next Work is to ſee if there be any Marcaſites to be found in the Superficies of the ſaid Mountains; which though they are uſually of divers Colours, and ſeldom good for any thing, yet they are ſtrong Signs of Minerals within, being themſelves the Spume and Froth of the better Metals, breathed forth, even as Drink breatheth up it's Yeſt or Froth to the Superficies.

And if they be put in an ordinary Fire, they will turn black, and yield a Smell of *Brimſtone*, *Arſenic*, *Antimony*, or ſome other thing, commonly called or known by the Name of a *middle Mineral*.

The next Work is to try the Operation with the *Virgulæ divina*, as beneath is declared; and where it ſheweth the ſtrongeſt Signs, as is likewiſe beneath taught, and alſo the Place is moſt accompany'd with the other Signs formerly mentioned; there, by digging or boaring, try your Fortunes.

The Operation with the *Virgula divina* is thus to be performed: Some obſerve a ſet

Day and Hour, with certain Words and Ceremonies at the cutting up of the ſame, which I have found to be little to the Purpoſe. Thus I wrought about Midſummer, in a calm Morning: I cut up a Rod of Haſel, all of the ſame Spring's Growth, almoſt a Yard long; then I ty'd it to my Staff, in the middle, with a ſtrong Thread, ſo that it did hang even, like the Beam of a Balance: thus I carry'd it up and down the Mountains where Lead growed, and before Noon it guided me to the Orifice of a Lead-mine, which I try'd, having one with me with an hacket of Iron and a Spade; and within two Hours we found a Vein of Lead Oar, within leſs than a Foot of the Graſs: The Signs that it ſheweth is to bow down the Root-end towards the Earth, as though it would grow there, near unto the Orifice of a Mine; when you ſee it does ſo, you muſt carry it round about the place, to ſee that it turneth in the String ſtill to the ſame Place, on which Side ſoever you ſtand.

The Reaſon of this Attraction I conceived to be of Kin to the Load-ſtone, drawing Iron to it by a ſecret Virtue, inbred by Nature, and not by any Conjuration, as ſome have fondly imagin'd.

And the Reaſon of this my Opinion was, becauſe that in divers of my practical Experiments I have obſerved an Attraction betwixt ſeveral things, like that of the Load-ſtone and Iron; and if it were to good Purpoſe, I ſuppoſe that I could ſhew more Experience of that Kind than any Man in *England.*

Now in the new Plantations, as *New-England*, *Virginia*, *Bermudas*, &c. where it is like that few or none have ever try'd, that had any Skill in theſe Affairs, it is very probable that the Orifice of divers Mines may be diſcerned with the Eye in the Clifts of the Rocks in many Places, as ſome have been in *England* at the firſt, before that Men grew a little skilful, and theſe to be loſt and neglected, were a Shame to the Planters; for theſe Mines if they prove rich, would yield more gain in one Year, than their Tobacco, and ſuch Trifles would yield in their whole Lives.

CHAP. III.

Now that we are come to the melting and refining of Metals, I will begin firſt with the Oar of Lead, *becauſe that is one of the moſt common Metals found in theſe Northern Countries.*

THE firſt Work therefore to be done, is to have a little Grate of Iron about a Foot broad, like ſuch as are uſed in a Still to make the Fire upon: This is to be placed in your Chimney-corner with looſe Bricks, one Thickneſs underneath, and empty in the Middle, to give Air to the Fire; then lay more Bricks above four Courſe high, round about, and if they be laid without Morter, the Fire will burn the better; then fill it with Char-coals kindled, in the midſt whereof ſet your Melting-pot, with one Pound of Lead-oar, and four Ounces of Filings of Iron mingled together, and ſo blow to it ſtrongly with a pair of good Hand-bellows, till it be well melted down; then let the Pot be taken out with a pair of Tongs, and ſet to cool; when it is cold, break it, and knock off the brittle Cinder lying upon the Top of the Metal with an Hammer, till none be left but the malleable Metal, which you may aſſay and refine in the Manner following: Take a little Teſt made as beneath, and place it in the middle of your Chimney; lay Aſhes about it, about ſix Inches broad, and as high, or rather higher than your Teſt; lay Bricks about the Aſhes to hold them up one Brick Thickneſs, and two Bricks broad, then lay about half a Peck of Char-coals upon the Teſt kindled, and when they are almoſt conſumed, and the Teſt red hot, put them by a little in the midſt over the Teſt, and lay over a piece of good Oak-wood about five Inches ſquare, and eighteen Inches long; lay it ſo upon two Tyle-ſheards, that it may lie about an Inch and an half above the Teſt, then lay on more ordinary Billets and ſome Char-coals amongſt; make the Fire about it ſo ſtrong as to roaſt a Pig, then blow to it a little, till the Fire burn clear, then put upon the Teſt two Ounces of your Lead, and blow to it gently, and in three quarters of an Hour, all the Lead will be conſumed, and the Silver will lie in the middle of the Teſt like a little Bead or Pearl; then put aſide the Fire, and let all be cold.

Then you may weigh the Silver in a pair of Gold-ſcales, and ſo caſt it up how much there is in a Tun of Lead. I have thus try'd many Oars, and have found them to differ in Goodneſs of all Sorts, from forty Shillings worth worth of Silver in a Tun to thirty five Pounds worth of Silver in a Tun, and there is no Lead but it holdeth ſome Silver, yet it is not worth the Refining, unleſs it yield eight or ten Pound upon a Tun at leaſt.

The Teſt may thus be made: Firſt, let a Smith make a Ring of Iron about four Inches wide, and two Inches deep, and a quarter of an Inch thick, and as wide above as beneath, and without a Bottom.

Then burn Mutton and Beef-bones in the Fire till they be white; then beat them ſmall in a Morter, and ſearce them fine like Meal; then with a little Beer or Water temper a ſmall Part thereof like Pap, then put ſo much more of the dry Powder by little and little, as will make it ſo ſtiff that it will be made into a Ball, but remain clammiſh, betwixt Powder and Paſte; then with a Peſtle ſtamp it gently into your Ring till it be Top-full, being ſet upon an even Board, then ſtamp it a little lower in the Middle, then at the Edges, and ſmooth it with a ſlight Stone, or ſome round Glaſs, ſo ſet it in the Chimney Corner, to dry a Day or two, and it is ready for your Work.

If you put a quarter of an Ounce of Sandivert, and as much Salt-petre mingled together with your Powder of Lead, and Filings of Iron at your firſt melting, it will melt ſomewhat ſooner, and with leſs blowing, beſides that the Cinder will part cleaner from the malleable Metal.

And if you want Char-coals, you may burn Wood in an Oven, and when it is red, and hath done ſmoaking, you may ſet up the Oven-lid, and damp it.

Or you may do the like in an open Chimney, and damp it in an earthen Pot, or cover it with Aſhes; or damp it in a Hole in the Ground, by covering it with a Cover, or with Aſhes.

Any of theſe Coals will ſerve to make your Aſſays and Trials. As for Directions for great Works here is nothing intended in this little Book; but only to be ſure whether the Work will quit the Coſt; which if it will, then Proviſion for great Works will eaſily be brought to paſs.

And if you want Pots, you may be at choice, whether you will buy the ſame at the Goldſmiths, or Potters in *London*, who ſell *Flanders* Melting-pots, or make them yourſelf by this Direction following:

Take right *Flanders* Juggs, ſuch as they uſually put Bottle-beer in, beat them to fine Powder, and ſearce them fine as Meal; take of this Meal four Pound, of the fine Powder of *Tobacco*-pipe Clay one Pound, temper them together with the red faitiſh Water, that iſſueth out of an Horſe Dunghil, beat it ſtrongly upon a broad Board with a Rowling-pin, till it be ſtiff Paſte, then faſhion your Pots upon a piece of Wood, turned like a Top, only let the ſharp End of the Top be thicker and flatter than an ordinary Top; then ſet them to dry in your Chimney Corner a Day or two; when you uſe them, ſet them in the Fire at the firſt kindling; and ſo let the Fire ſteal upon them till they be red hot; then put in your Metal and Ingredients, and cover it with a Tile-ſheard, or cover of Iron, and ſo melt it down.

CHAP. IV.

Wherein is ſhewed the Operations of Tin.

THIS Metal may be melted down like the Lead, only omitting the Filings of Iron; but when it is melted it is not malleable, till it be compounded with certain Proportions of other Metals, which I will not declare, becauſe it is a Secret of Weight belonging to the Pewterers Trade.

And as for refining of it, I am ſure it cannot be done by any Artifice; for I ſuppoſe that I have try'd more Experiments about it, than any ten Men in *England*, becauſe that I ſaw the Refiners could not do it; therefore I took the more Pains and Induſtry to bring it to paſs; which if I could have affected, I do verily believe it would have proved a rich Metal; but the more I try'd the worſe I ſpeed, for at the laſt I melted Gold and Silver equal parts with the Tin, thinking thereby to bring it down into the Lead, and to make it to drive fair, and refine kindly, but all was vain, for the Tin poyſoned and conſum'd ſome of my rich Metals.

Now as there is no Hopes of any Royal Metal ever to be gotten out of this Mineral; to ſupply the Shortneſs of this Chapter, I will ſhew a Way, how every one that hath a mind to meddle with theſe Affairs, may have good poſſibility to enrich themſelves and their Poſterity; and be out of Danger to undo themſelves, or to damnify themſelves in any Manner of Value that is conſiderable.

For my Meaning is, in the taking in hand of this Task, to do Good to all, and Hurt to none; and that no Man from henceforth ſhall need to be at a quarter of Charge, Study, or Labour, which I myſelf have undergone.

Therefore ſeeing that if the moſt ingenious and exquiſite Ways be taken in the Deſign that Wit can attain unto, yet it is but an Adventure; for ſometimes all the Labour may be loſt, though not often, if good Heed be taken; and ſometimes Mines may be found, which will not quit the Charges to be wrought upon.

Therefore, as wiſe Merchants will not hazzard all in one Bottom, ſo let this never be any Man's Deſign totally; for now there is no ſuch need but they may do all that can be done at ſuch ſpare Times, as any Gentleman, or Man of Quality, uſually ſpendeth in Hawking, Hunting, Gaming, or other Pleaſures; whereof he needs but ſet a part of that Time for theſe Purpoſes; having the moſt part of his Work done to his Hands in this little Book.

If the Refiners ſhall grudge at me, for diſcloſing ſome of the Secrets of their Trade, I will anſwer them in this Manner: Firſt, I myſelf have ſpent the Time of divers Apprentiſhips in theſe Affairs, and therefore claim a Privilege to diſcloſe my Experience for the public Benefits at my Pleaſure.

Secondly, I affirm, that there can be no Damage to any Refiner, by the divulging of theſe Secrets; but on the contrary, a great Probability of much Gain to that Trade; for that, here is nothing but the Skill to make the Aſſays diſcloſed for the Searcher's Satisfaction, before he take in hand great Works; which if he find Cauſe ſo to do, I adviſe him to chuſe the beſt Workmen that he can get, and one that hath been long experienced in theſe Works and in ſo doing he ſhall proſper the better in his Deſign: and if every Year ſome increaſe of that Trade ſhall be entertained in theſe Affairs, as there is good Probability they may; the reſt will have Cauſe to give me Thanks for my Pains, rather than opprobrious Speeches.

CHAP. V.

Wherein is ſhewed the Operation of Iron.

AS for the melting hereof, ſeeing that it is no Work to be done in the Chimney Corner, I will turn over the Reader to learn the Practiſe thereof in every Country almoſt where he ſhall come.

As for the Refining thereof it may be done in this Manner: Take Filings of Iron two Parts, Antimony one Part, it will melt down like your Lead Oar; take the pure Metal, which will be much more brittle than the Lead was, and melt it with four times as much Lead as it weigheth, then refine it, as before is taught; if you know the Goodneſs of your Lead before, you may know the Augmentation out of the Iron, which will not quit the Charges out of any Iron made in theſe Northern Countries, nor yet out of Spaniſh Iron; but what it may do out of Iron made in the burning Zone I know not; but I conceive it may do well, if any ſuch Iron can be found and made in that Climate.

It is true, that good Gold may be extracted out of any Iron, but not by any common Way, but by a tedious, laborious, and coſtly Way; and when all is done, there will be no Gain, unleſs it be in Conceit, which ſatisfieth no Man, but thoſe who are of my Diſpoſition, who think Experience to be the greateſt gain in the World.

CHAP VI.

Wherein is ſhewed the Operations of Copper.

FIRST, take your Oar, and break it into little pieces, about the Bigneſs of a Hazel Nut; then lay a Leer of ſmall Char-coals an Inch thick in your Chimney Corner; then lay on your pieces of Oar; then lay on more Char-coals an Inch and an half thick upon the Oar, then kindle and let the Fire burn out of itſelf.

Then beat it into ſmall Powder, and mingle it with your Sandiver, and Saltpetre, as you did your Lead, without any Filings of Iron, and ſo melt it down as you did your Lead Oar; only this Difference muſt be uſed, by Reaſon that it is harder of Fuſion than the Lead Oar; therefore you muſt lay the Bricks ſomewhat wider than you did for the Lead, that it may hold more Coals; beſides that you muſt take the choiceſt Coals that can be pick'd out, and no very ſmall ones amongſt them; alſo you muſt have two Pair of Hand-Bellows, and two Men to blow very ſtrongly, and ſo melt it down.

As for the refining it is needleſs to ſhew the Manner; for no Copper in theſe Northern Countries holdeth any royal Metal, that is conſiderable; neither *Engliſh* nor *Dantzic* Copper; yet in Regard that in ſome Mines in *Hungary*, there is generated Gold, Silver, and Copper, all in one Maſs of Oar; and alſo in Regard that if any Mines of Copper ſhall be diſcovered in *Virginia*, or other Southern Countries, there is ſome good Probability that it may contain royal Metal; therefore I will ſhew the Manner how to refine it, and alſo to part the Gold from the Silver, if it contain both together.

Firſt, melt one Ounce of Copper with four Ounces of ſuch Lead as you know the Goodneſs of before; then refine it, and by the Augmentation, you ſhall know the Worth of the royal Metal contained in the Copper.

If you would try whether the Copper contained any Gold in it, put the Aſſay, *viz.* the little Bead or Pearl of Silver into good Aqua-fortis well purify'd before, and if all diſſolve then the Copper held no Gold; but if it leave a black Powder undiſſolved, that is Gold; for Lead holdeth no Silver that hath any Gold in it at all; therefore it is evident that the Gold came out of the Copper.

But if it happen, as often as it doth in the refining of baſe Metals, eſpecially Tin, Iron, and Copper, that the little Bead, or Pearl remaining in the middle of the Teſt, is not bright and ſhining, like the Eye of a Bird, or Fiſh, but rough, black, and full of Scurf; then if it be but a little in Quantity, and that the Teſt be not crack'd, nor full of Clifts, then put to it ſome more of the ſame Lead, whereof you know the Goodneſs, and drive it off again as you did at the firſt; and re-iterate this Work till the Aſſay be pure and clean like a little Pearl, or Bead, as it ought to be.

But if it happen that the Teſt is very foul, as often it cometh to paſs in the Refining of ſtrange Minerals, as *Marcaſites*, and eſpecially thoſe which the Mineraliſts call by the Name of *Devil's Dirt*; then there is no Way but to let all cool; and then to dig it out, and with more Lead to melt it again in a Pot, and then to let it cool, and then to break the Pot, and to beat off the Cinder with an Hammer, till you come to the malleable Metal, and you may be aſſured that no Royal Metal will ſtay in the Cinder, but ſink down into the Lead, through an Attractive Virtue betwixt them.

CHAP. VII.

Wherein is ſhewed the Operations of Silver.

AS for the melting thereof, when it is found in the Mine of Lead, the Operation is taught in the Chapter of Lead; but if it be found by itſelf, or mix'd with Gold without Lead, as many times it cometh to paſs, then it is to be beaten to Powder, and mix'd with Sandiver, and Salt-petre, without any Filings of Iron, and ſo melted down like the Lead Oar; only the Fire muſt be ſomewhat ſtronger.

Then it is to be melted with four times as much Lead, whereof you know the Goodneſs; and ſo to be refined, as before is declared.

But whereas ſometimes this Oar is ſo ſtrongly mix'd with Sparre, and ſtony Subſtances, that it cannot be ſeparated therefrom, by any common Manner of Work uſed by the Refiners, then this Courſe is to be taken with it: Firſt, beat it into ſmall Powder, then waſh away with Water the greateſt part of the Terreſtreity and Filth; then dry the Powder, and uſe it in this Manner:

Firſt, melt four Ounces of Lead, and when it is melted, put to it four Ounces of

Quickſilver, made hot in another Melting-pot: but let the Lead be almoſt cold before you put it to the Quick-ſilver; but yet it muſt be done whilſt that the Lead is liquid.

This done, caſt it into an Iron Morter, ſet warm before upon Embers, and it will be like Pap; then preſently with a Peſtel, labour in one Ounce of your Powder, or two at the moſt, till it be incorporated; or ſo much thereof as will incorporate; for the ſtrong and earthy Subſtance will not incorporate with the Lead and Quickſilver by any Artifice whatſoever: but the Silver, if any there be, will forſake the earthy and ſtony Subſtance, and join itſelf with the Lead and Quickſilver by an attractive Virtue. This done, put it altogether into a Melting-pot, with a little Sandiver and Saltpetre, and melt it down as you did the Lead Oar; only this muſt be obſerved, that the Fire muſt be more mild at the firſt a great deal, till the Quickſilver be evaporated, and more ſtrong at the laſt, that all may flow well together. Then take out the Pot, and let it cool; then break it, and with a Hammer beat off all the Cinder and Scurf, till nothing be left but malleable Metal.

Then refine it according to the common Manner before declared, and caſt up with your Pen the Augmentation that is more than the Lead yieldeth of itſelf: And if there be no Augmentation, then that Mineral Stone contained neither Gold nor Silver; for this is the moſt exquiſite Way in the World to reduce Gold or Silver, which is hard to be reduced to a metallical Body, through being ſtrongly mixed with either corroſive Subſtances, or any other Filth which hindereth it's Reduction: Therefore if this Way fail, you may ſet your Heart at reſt for the ſeeking out of any other Devices whatſoever, though the gliſtering Sparks contained in the ſaid Minerals do never ſo ſtrongly invite you; and you may conclude with the old Saying, that all is not Gold that gliſters.

But if it proſper, and yields any Augmentation that is conſiderable; then if you deſire to know whether there was any Gold mix'd with the Silver, as oftentimes there is, where Silver is found without Lead, then put the little Bead, or Pearl of Silver, which remained on the Teſt into *Aquafortis*, and if all diſſolve, then there is no Gold in that Mineral; but if a black Powder remain, then that is Gold, and the Quantity may be found by farther Trial.

CHAP. VIII.

Wherein is ſhewed the Operations of Gold, and real Experiments whereby any Man may preſently try whether any Pieces of Gold be true or counterfeit, without defacing or altering the Form thereof.

AS for the melting of it; if it be found mix'd with Silver Oar, as oftentimes it cometh to paſs, then it is to be melted, refined, and parted from the Silver, with *Aquafortis*, as is before declared; and if there be not five times as much Silver as there is Gold in the Compoſition, then you muſt put to ſo much, or elſe the *Aquafortis* will not diſſolve it.

But if it be found in Grains or Powder, as oftentimes it is, then you muſt put to it *Borax* inſtead of Sandiver and Salt-Petre, and ſo melt it down as you did the other Oars before mentioned.

Now as this Metal is the moſt rich of all the reſt, and moſt thirſted after, I will enlarge my Diſcourſe for the gaining of Means to find it out; alſo I will ſhew the Reaſon why this royal Metal is many Times found pure of it ſelf, with little or no Mixture of other baſe Metal with it.

And firſt, whereas it is often found in the Sand in Rivers, let no Man think that it could be generated there, but that the ſwift Motion of the Water from the high Mountains, brought it thither, with Earth and altogether, till ſuch Time as the Motion of the Water grew more ſlow; and ſo according to it's Property, being not able to carry forward ſtill both the Subſtances, did ſtill carry the Earth with it, and let the heavier Body ſink.

Therefore I would have thoſe that have Occaſion to deal in the hot Countries where Gold is uſually generated, to make trial in all ſuch Rivers which run from great Mountains with a ſwift Courſe in ſuch Places, where the Motion of the Water beginneth to grow ſlow.

And for this Purpoſe he may have a little Bucket of Iron that will not lie in the Bottom, but on one ſide, which Side muſt have a Shoe like a Shovel; ſo that being drawn a little forward, as it lies in the Bottom it will fill itſelf with Sand: Which you may try by grinding it with Quickſilver whether it contain any Gold: For if there be any Gold in the Sand, it will mix with the Quickſilver willingly: Then you may waſh away all the Sand, and ſtrain the Quickſilver through a Skin of Leather, and if any Gold be gathered into it, there will remain a Ball in the Leather: Then you may evaporate the Quickſilver from the Ball in a melting Pot, and ſo melt down the Gold with a little *Borax*.

Alſo ſometimes Gold is found in Rivers, in Powder and Grains, far diſtant from any

Mountains, of ſwift Motion of Water: This plainly demonſtrates that the Earth thereabout contains Gold, a Thing uſually in hot Countries, and that the Water in that Place had a convenient Motion to wear away the Earth, and to leave the Gold behind; and this is manifeſtly ſeen by Experience where they waſh whole Mountains of Earth with Water, thereby to ſeparate the Gold from it.

Now as I have formerly affirmed that all Metals in general are generated of the clammy and glutenous Part of the ſubterraneal Vapours ariſing from bituminous and ſulphurous Subſtances, kindled in the Bowels of the Earth, it behoveth me to ſhew how Gold, uch a fixed Subſtance, can be found pure of itſelf, and not mixed with other baſe Metals.

And the Reaſon of this can be no other, but becauſe that all other Metals whatſoever will putrify in the Earth in Length of Time, and turn to Earth again; but Gold will never putrify by Reaſon of it's excellent Compoſition, being made of a balſamic Sulphur, or Fatneſs, which is incombuſtible, and differeth from the Sulphur or Fatneſs contained in other Metals, even as natural Balſom differeth from all other Oils, and fat Subſtances: So that though it be an Oil in ſhew, yet it will ſink in Water, whereas all other Oils will ſwim upon the Top of the Water.

And this is the Cauſe why Gold ſinketh ſo eagerly in Water, which may be proved by weighing a twenty Shilling Piece of Gold, againſt a Braſs Weight, and then letting the

Scales ſink in a Baſon of Water three or four Inches deep, the Gold will there over-weigh the Braſs about nine or ten Grains by Reaſon that the Braſs is more inclined to ſwimming through the combuſtible Fatneſs or Sulphur in it's Compoſition; and as for the twenty Shilling Piece, ſo for any other Piece of Gold whatſoever according to it's ſeveral Braſs Weight you may in like Manner try *whether it be true or counterfeit.*

Now whereas the Subſtance of Gold is not ſubject to putrify in the Earth by any Length of Time, it is probable enough that other Metals might be generated with it at the firſt, and afterward putrified and conſumed from it in Length of Time, leaving the Gold pure,

For I have drawn Iron, or a Subſtance much like to Filings, or Atoms of Iron out of grain Gold that was brought from *Guinea* with a Load-ſtone, which ſeem'd to be Iron not fully putrified and turned into Earth.

And the Reaſon why the hotter the Country is, the richer the Minerals are, can be no other but the ſame, that roaſted Meats are ſweeter than boiled Meats, or raw Meats: The Reaſon whereof is plain, for that the rawiſh and unſavory Part is exhaled by the Heat of the Fire, leaving the ſweeter Part behind.

Even ſo in hot Countries, all that Part of the ſubterraneal Vapours, which here is condenſed into Lead, and other baſe Metals, can there have no leave to congeal, by Reaſon of the Heat: But is all or moſt Part thereof exhaled out of the Mines, leaving behind the royal Metals, whoſe Property is to coagulate with Heat: Whereas the Property of the baſe Metals is to evaporate with Heat and to congeal.

The contrary Opinion to this; namely, that the Subſtance of the beſt Metals are convertible into royal Metals by Heat and Digeſtion, hath filled the World with falſe Books and Receipts in Alchymy, and hath cauſed many Men to ſpend much Money, Labour, Study, and Charges to no purpoſe.

For I know, by good and long Experience, and by may accurate Trials, that Quickſilver, the moſt friendly Mineral to the royal Metals, can by no Means, or Artifice whatſoever, be fixed or coagulated into either of the royal Metals. Alſo I have found ſince, that no Author of Credit or Reputation teacheth any ſuch Thing; but, on the contrary, condemns all ſuch Operations to be falſe.

For the Subſtance of the royal Metal is quite contrary to that of baſe Metals, even as the fixed Salt of any Vegetable, is different from the volatile or fugitive Salt of the ſame. Yet I don't deny but by Art there may be drawn ſome ſmall fixed Part out of the baſe Metals, which may be converted into royal Metal, though with much Labour, Charge, and Loſs.

For as a Tree, or other Vegetable, being burned, doth yield a fixed Salt, or Aſhes, ſo the baſe Metals do contain ſome ſmall Quantity of Matter, of the ſame Nature that the royal Metals are compounded of.

And, for the further Satisfaction to the Reader, I will ſhew, in the next Chapter, a true Receipt how to make true Gold, abiding all Trials, and having all Properties, active and paſſive, which true natural Gold hath; but, inſtead of Gain, Loſs will be ready to follow the Work.

CHAP. IX.

Wherein is ſhewed how true and perfect Gold may be made by Art, with Loſs to the Workman.

Thus I wrought.

I Took 8 Ounces of Regulus of Iron and Copper, made as beneath is declared, and 16 Ounces of common Sublimate, bought at the Apothecaries, and made theſe Ingredients into fine Powder; firſt ſeverally, and then I ground them well together upon a Marble Stone, and ſo put them into a Retort of Glaſs, and drew from them firſt an Oyl, then a Subſtance like Butter, and laſtly a yellow Sublimate, tincted with the Tincture of Iron and Copper, which yellow Sublimate I rectified three or four Times, till it was very pure; then I mixed it with equal Parts of an Amalgam of Silver and Quickſilver, made as beneath is taught, and put it into another Retort of Glaſs, and forced away all but the Silver, which remained like yellow Horn; this yellow Silver I amalgamed again with new Quickſilver, and ſet it in gentle Heat about a Week, then in a very ſtrong Heat for ſix Hours; ſo that the Quickſilver roſe up, and fell down again upon the Silver, till ſuch Time as it had carried up all the Silver from the Bottom of the Glaſs, into Branches like Trees; then I melted down the Silver, and fined it, and parted it with *Aqua-fortis*, and had diverſe Grains of pure and good Gold, abiding all Trials; but the Quantity would not pay for half the Charges and Labour.

I made the *Regulus* thus: I took 4 Ounces of Iron in ſtub Nails, and made them red hot in a Crucible, and then I put to it 8 Ounces of crude Antimony, and melted it down, and when it was well and thin melted, I let it cool in the Pot, and ſo knock'd off the Regulus from the Lop or Cinder, which lay upon the Top of it; then I did the like with 4 Ounces of Copper, in thin Plates; and then I mixed equal Parts of theſe two, and melted them three or four times, every time caſting into the Pot half an Ounce of Saltpetre, as it was in melting, to purify it, till it was pure and bright almoſt like Silver, but yet brittle, ſo that I could beat it in a Morter to fine Powder.

The yellow Silver that was like yellow Horn did amalgam, with much Difficulty and Grinding, with Salt and Vinegar, and ſome of it was loſt, do what I could; but the firſt Silver was water Silver, which I bought at the Refiners, out of which they had taken all the Gold before; this did amalgam very eaſily; then I ſtrained it to a Ball through a Leather Skin, and ſo mixed it with the yellow ſublimate that was tincted yellow with the Tincture of Iron and Copper.

The Proportion of the Quickſilver to the Silver was five or ſix Parts to one.

If any one doubt the Truth of Alchymy, he may be ſatisfied by this Trial; but, inſtead of Gain, he ſhall pay for his Learning, by going away with Loſs.

I do not deny but there are Works of leſs Loſs and Charge, yet none of them lucrous, by reaſon of the Change of Times.

For if any one will uphold me as good a Leaſe, or Purchaſe of Land, as I can prove by credible Records, hath been had in former Times for an Ounce of Gold, I will undertake to make an Ounce of Gold by Art to pay for it, and yet have a good Bargain.

But the Difference of Times hath confounded this Art, as may appear more plainly beneath.

Firſt, In ancient Times a Man's Work was not worth above a Penny a Day, which now is worth two Shillings and Sixpence a Day, as may appear by ancient Records for Buildings, and the like; ſo that there is thirty to one Loſs in the Workmanſhip.

Secondly, Then Coals, Veſſels, and other Things neceſſary for theſe Affairs, did coſt little in reſpect of the Charge now.

Thirdly, When the Gold was made, it would then have bought thirty or forty times as much, either Lands, Leaſes, Victuals, or Workmanſhip, as now.

So I conclude, that then the Owners of this Art might gain thirty or forty for one, and yet now they ſhall looſe extreamly.

CHAP. X.

Wherein is ſhewed the Operations of inferior Minerals.

AS for theſe baſe Minerals, *viz.* Cinabar natural, Antimony, Sulphur, Auripigment, Arſenick, Talcum, *Muſcovy* Glaſs, Emery, and many other Things of like Nature, becauſe they are of ſmall Value, and not worth the ſeeking for on purpoſe, I will omit further to diſcourſe of them; if any Man ſhall find them, or any of them, by accident, let him uſe his own Pleaſure, Skill, and Induſtry in the proceeding of them.

Nevertheleſs, becauſe Cinabar natural may contain much Quickſilver, which is very uſeful for many Things; and may prove as beneficial as a good Mine of Metal, eſpecially if it be found in great Plenty. I will therefore ſhew the refining Separation, and purifying of the ſame in ſmall Proportion; ſo that if it ſhould be found a profitable Work, then the Finder thereof may proceed to a greater Work. The firſt Thing then to be done, is to conſider of the Weight thereof; if it be very ponderous, reddiſh in Colour, and full of clear Streaks, ſhining almoſt like the Streaks of Antimony, then it is a good Sign of a rich Mine.

The firſt Trial to be made thereof, is to weigh a Piece thereof, and ſo put it into a gentle Fire, for an Hour or two, that it may be only red hot; then let it cool, and weigh it again; and ſo, by the Lightneſs thereof, being compared with the former Weight, you may judge ſomewhat of the Richneſs thereof.

Then take a Pound thereof, and beat it into fine Powder, and mingle it well with as much unſleck Lime, put it into a Retort of Glaſs, luted with Potters-Clay, and ſome Horſe-Dung, well beaten and tempered together; then ſet it in a little Furnace in your Chimney Corner, and force it with Fire twelve Hours; let it be kept red hot the laſt four Hours; and let the Noſe of the Glaſs enter into another Glaſs, filled almoſt full of Water, in ſuch manner, that the Vapours of the Cinabar muſt needs enter into the Water, for the better Condenſation thereof into Quickſilver.

This done, ſeparate your Quickſilver in the Bottom of the Water, and dry it and weigh it; if you find the Quantity conſiderable, then you may proceed in this manner.

Firſt, Make a Hole in the Earth, with very good tempered Clay that will hold Water, and let it be narrow in the Bottom, and wider and wider above to the Top, to the Breadth of two, three, or four Yards; then fill the Pit with Water, and lay over it Bars of Iron, of ſufficient Strength and Thickneſs to bear the Burthen that muſt lie upon it; and then let them lie ſo near together, that the Stones and Wood cannot fall through; then lay thereupon a Leer of dry Wood, and a Leer of your red Stone, not broken ſmall; and ſo do again, till it be a Yard thick, or more; then give

Fire to it on the Wind-ſide, and go away out of the Danger of the Fumes, till you ſee afar off that the Fire is finiſhed and burned quite out.

Then repair to your Work, and let out the Water through a Pipe of Lead, which ſhould be formerly laid almoſt at the Bottom of the Pit, into another Pit near to it, made ſo deep that it may receive the Water; and in the Bottom you ſhall find great Store of Quickſilver, if the Mine was good.

The Water may be pumped up again, to ſerve the next Day for the ſame Uſe; and you need but to take up a few of the Bars of Iron every Day, to go down into the Pit, to take out your Quickſilver, and ſo lay them down again.

CHAP. XI.

Wherein is ſhewed the Way to find out Pit-Coal; alſo the natural Cauſe of the Generation of them, by a plain Demonſtration.

THOUGH this Mineral be of ſmall Value, yet if a good Mine thereof ſhall be diſcovered in ſome particular Places of this Land, the Benefit thereof will far exceed the Profit of any Metal Mine uſually found in theſe Northern Countries, by reaſon that Wood is ſo greatly decayed of late Years; that were it not for this Help, many People would be in danger to be ſtarved.

The firſt Thing, therefore, which I would have to be diligently obſerved is, that this Mineral is uſually found in Ground that is prone to bear Wood and Thorns; and not in the very fertile Grounds, nor yet in the extream barren Grounds, but of an indifferent Fertility, and in Grounds that are uſually ſlower in their Growth in the Spring Time, than the fertile champion Countries by a Week or a Fortnight.

Alſo the ſaid Grounds are prone to bring forth large Cattle, and well horned; but not to feed the ſaid Cattle without a long time, nor yet will they ever be very fat upon the ſame Ground. Alſo the Springs iſſuing out of the ſaid Grounds, are apt to colour the Earth ruddy at their Orifice, like unto the Ruſt of Iron.

Alſo the ſaid Spring Water being boiled, as before is taught, doth uſually yield a black Reſidence.

Alſo if you bury a new Bowl of pure white Wood in the ſaid Grounds, from *March* till *Midſummer*, with the Mouth downward, it will be coloured blackiſh with the ſubterraneal Vapours.

I had a Receipt given me, for this Purpoſe, by one that, for his great Experience and excellent Skill in natural Cauſes, ſeemed to be one of Nature's Darlings; which, becauſe I have not tried, for want of Opportunity, I will commend it as a very probable Sign, and give ſuch Cautions, that any Man may be ſure of it, before he try his Fortunes by digging or boaring, or any chargeable Way.

And this was his Direction: *About the Middle of* May, *when the ſubterraneal Vapours are ſtrong, which may be diſcerned by the Fern, which about that time will ſuddenly grow out of the Earth in a Night or two, almoſt an Handful in Length, then take a pure white Piece of Tiffany, and wet it in the Dew of the Graſs, which is all of that Spring's Growth, and not ſpoiled with Cattle, nor other Thing, than wring out the Dew from it, and do ſo five or ſix Times, and if there be Coals, the Tiffany will be a little blacked, and made foul with the ſooty Vapours ariſing through the Coals, and condenſed amongſt the Dew.*

Now, to be ſure not to be deceived, do thus: Firſt try where there are Coals, and if you find the Signs aboveſaid, yet truſt not to the Experiment, till you have tried where there is no Coals in ſome other Place, wherein it behoveth you to try in diverſe Places, till you find a Place where the Tiffany is not ſoiled at all; then you may be ſure that the Experiment is true and infallible.

I admoniſh him that ſhall try with the Tiffany upon the Dew, to let his Hands be waſhed before with Soap and hot Water, and wiped with a pure white Cloth, till they will not foul the Cloath at all; elſe if they ſpend their Money in digging, and find nothing, they may thank their foul Fingers for that Miſfortune.

As for the natural Cauſe of the Generation of Coals, this Demonſtration following doth make it manifeſt.

Take a Piece of the black fat Earth, which is uſually digged up in the Weſt Country, where there are ſuch a Multitude of Fir-trees covered therewith, and which the People uſe to cut in the Form of Bricks, and to dry them, and ſo to burn them inſtead of Coals; uſe this Subſtance as you did the other Earth, in the Beginning of the Book, to find out the natural Cauſe of Rocks, Stones, and Metals; and let it receive the Vapours of the combuſtible Subſtances, and you ſhall find this fat Earth hardened into a plain Coal, even as you found the other lean Earth hardned into a Stone.

Whereby it appeareth, that Nature doth the ſame thing in the Generation of Coals under the Ground, by the indurating of a fat Earth with the ſubterraneal Vapours, which are apt to work a various Effect, according to the Subſtance which they meet withal.

Now, whereas ſome of inquiſitive Diſpoſitions will deſire to know the natural Cauſe of that fat Earth, generated in ſuch ſubterraneal Caverns, let them be pleaſed to conſider that ſuch Places, in former Times, have been the Superficies of the Earth, and afterward have been covered by the Sea with other Earth; which may be demonſtrated by two Ways. *Firſt*, It is evident that the Mines of Coals do lie in ſome Places higher, and in other Places lower, lively reſembling the Superficies of the Earth, which is never directly equal, but every where various.

Secondly, Every one may ſee in the Weſt Country, where ſuch a Multitude of Fir-trees do lie covered ſo deep in the Earth, that the

Superficies of the Earth is deeper now than it was in former Ages, when thoſe Trees were brought thither by the Sea; for it is evident that they never grew there; *firſt*, for that there groweth no Fir-trees in that Country; *ſecondly*, that they lie croſs, and in ſuch uncooth Manner, that no human Strength could ever imitate nor parallel, by any Divice whatſoever.

Alſo they may ſee the Power of the Sea, to alter the Superficies of the Earth, by the Multitude of Earth there laid ſo many Yards deep upon the Top of the Trees.

Alſo they may ſee that the Sea doth make the Difference of the Nature of Earths by it's various Motion, as well as the Unevenneſs thereof by Hills and Vallies; for there they may ſee, that ſome Earth will burn, and ſome will not burn, being both Sorts brought thither by the Sea, as appeareth evidently by the former Diſcourſes.

Alſo the Sea never reſting, but perpetually winning Land in one Place, and loſing in another, doth ſhew what may be done in Length of Time, by a continual Operation, not ſubject unto Ceaſing, or Intermiſſion.

CHAP. XII.

Wherein is ſhewed a perfect Way to try what Colour any Berry, Leaf, Flower, Stalk, Root, Fruit, Seed, Bark, or Wood will give; alſo a perfect Way to make Colours fixed, which will not abide the ordinary Way.

HERE I muſt confeſs a manifeſt Digreſſion from my Subject; yet in regard of the great Benefit which this Experiment may bring to the Country, out of the new Plantations, and other Places, where it is very probable that many of theſe Things be hidden and unknown, I will crave Pardon, for that my Intent was chiefly to prevent the Loſs of thoſe Things, which may do much Good, were it not through Ignorance, or Negligence.

Firſt then, take half a Pint of Water, and half a Pint of Float, made as beneath, Two-penny Weight of Allom, 12 Grains of Tartar finely beaten, put all into a Tin Veſſel, which is better than Earth, Lead, or Copper; ſet it on a Trivet, to diſſolve the Allom, upon a gentle Fire; as ſoon as it beginneth to boil, take a Piece of white Wollen Cloath, well ſcoured with Soap, Fullers-Earth, or Lee, or altogether, to take out the Greaſe of it, being well waſhed out with fair Water, and then dried in the Air or Sun, not by the Fire; the Cloth muſt weigh but half an Ounce; then tye a Thread to the End of the Cloth, and when the Liquor beginneth to boil, then put in the Cloth, and let it boil an Hour; then take out the Cloth, let it cool, waſh it in two or three Waters; then take any Berry, Leaf, Flower, Stalk, Root, Fruit, Seed, Bark, or Wood, and bruiſe them well; put them in fair Water, and boil them with a gentle Fire, to extract the Tincture; then put in the Cloth formerly prepared, which will ſhew what Colour they will give.

To make the Float.

Boil an Hogſhead of Water; then caſt in a Buſhel of Wheat Bran; then draw the Fire; then let it ſtand three or four Days, till it grow ſoweriſh.

But for ſmall Trials a little will ſerve, obſerving Proportion between the Water and the Bran.

A Proportion muſt be obſerved in the allowing of all Stuffs before they receive their Colours. *Firſt*, The Proportion of Allom to the Water; which is one of Allom to ſixteen of Water, and Float. *Secondly*, The Proportion of the Tartar to the Allom; which is one of Tartar to four of Allom. *Thirdly*, The Proportion of Allom to the Cloath; which is one of Allom to five of the Cloath.

Note, That all Silks muſt be allomed cold, or elſe they will loſe their Luſtre.

The Way to find what Tincture is hidden in any Vegetable, or in any Part thereof.

Take the Vegetable, being cut green, and ſtamp and grind the ſame, as if it were to make Juice thereof; then preſs out the ſuperfluous Moiſture; the Remainder make up in Balls, and lay them up together, that they may gather a little Heat; but let them not heat too much, for then they will turn to Dung. Theſe being ſufficiently fermented, muſt be dried, and afterwards uſed as Oad is uſed.

Another Way, as Indico is made.

Make a Pit with Timber and Boards, about a Foot deep, and as wide and as long as you pleaſe, being well clayed in the Bottom and Sides; then fill this Pit with any Vegetable cut green; then put as much Water to it as will cover the Herbs; let it ſtand expoſed to the Sun two or three Days; then with a Plug at the Bottom draw out all the Water, and caſt it away; then fill the Pit again with freſh Water; and when it hath ſtood the like Time, draw it away as the former. This do ſo often, till you find that the Herb will be eaſily brought into a Mucilage; then it muſt be trod, and beaten with wooden Inſtruments like Rammers, till it will all come to a Mucilage; then it muſt be taken and wrung through Hair Sieves, like *Caſſia Fiſtula* extracted, to keep the great Stalks and Fibres from paſſing through; afterwards the Mucilage or Pap that paſſeth through muſt be dried in the Sun, and ſo formed into Cakes like to Indico.

Another Way.

Take the Vegetable cut green, and ſtamp and grind it; then take an Hogſhead and fill it, with half Water and half bruiſed Herbs; ſet it out of the Sun, with the Bung-hole open two or three Inches, till it ferment and work like Wine or Beer; after it hath done working the Herbs will ſink, which at the firſt did ſwim, and the Liquor will grow a little ſoweriſh; then let it be ſet abroad in the Sun, and brought into Vinegar, as Wine and Beer is brought into Vinegar; and then that Colour can never be ſtained with other Vinegar, or Urine, becauſe it is ſufficiently impregnated, and it's Appetite ſatisfied with it's own proper Vinegar. When it's Subſtance is thus turned into Vinegar, the clear Vinegar muſt be drawn from it; the Remainder muſt be uſed as the former Indico, and ſome Water to that, to be ſure to fetch out all it's tartarous Mucilage, muſt be put to the Vinegar, and dried away in the Sun, and ſo they come like Indico: *In tincturam tartarizatum fixam de occulto in manifeſtum.*

And whereas Barks, Woods, and Roots are of a dry Compoſition, and will not ferment of themſelves with Water, like green Herbs, or Vegetables; therefore they muſt be well ground, or thin ſhaven, and there muſt be added, inſtead of Water, Juice of Grapes, Pears, Apples, or Wort made of Malt, or other Grain, to which the Wood, Bark, or

Roots muſt be put. Let them ferment together, and afterwards be turned into Vinegar; then the clear Vinegar muſt be extracted; the Reſidue of the Tincture muſt be extracted with freſh Water, and both of them muſt be breathed away in the Sun, as before, and ſo brought in it's perfect Tincture.

By what hath been declared in this Chapter, it may appear to every one having an inquiſitive Diſpoſition, what is the true natural Cauſe why ſome Colours are fixed, and will not ſtain with Vinegar, Urine, nor yet fade with the Air; which hath in it a certain Acetoſity, or ſharp airy Salt of the Nature of Vinegar, which thoſe Tinctures draw to them, which have not their Appetites fully ſatisfied before with ſuch ſpiritual or airy Salts. And this is further manifeſt; for that all ſuch Tinctures which are moſt firm and fixed, and are not ſubject to Staining or Fading, being taſted upon the Tongue, may be felt ſomewhat ſharpiſh or ſoweriſh.

And the Cauſe of this appetitive and attractive Virtue in Colours, is no other but the very ſame which is betwixt the Load-ſtone and Iron; for take the Load-ſtone and burn it till all it's blue Vapour be exhaled, and it will draw no more Iron; thereby ſhewing plainly, that it was that airy Salt, tincted with the veneral or vegetable Greenneſs, which the Iron thirſted after, to ſatisfy it's thirſty dry Nature and Conſtitution, which it got by it's Calcination and Fuſion.

And the like Attraction may be diſcerned by the intellectual Eyes, in any thing that is ſtrongly burnt; ſo that all Spirits are exhaled.

As Lime will draw the airy Subſtance to it, and thereby quench itſelf; alſo Tartar burned, and laid in the Air, will draw the ſharper Part of the Air to it, and thereby diſſolve itſelf; and, in fine, all corporeal Subſtances, the more they have loſt their ſpiritual Parts by natural or artificial Operation, the ſtronger is their attractive Virtue.

Now, inſtead of filling the Reader's Head with Proclamations, I will conclude my Book with giving Eaſe to his Memory, by preſcribing what Neceſſaries he is to provide for the accompliſhing of his ſeveral Deſigns, in his Voyages, or Plantations, whither his Occaſion ſhall draw him.

And firſt for him that will only try his Fortunes in the Searching for Minerals.

He will need nothing but two or three Pipkins, two or three Urinals, an Iron Pick-axe, well ſteeled, a Spade and Crow of Iron, if he will be at the Charge thereof, but there is no great Neceſſity; alſo if he be not acquainted with the ſeveral Oars of Metals, it will be convenient that he take with him a little Piece of every Sort of Oar, or ſo many ſeveral Kinds as he can get.

And for him that would proceed further, to try the Value of them himſelf, he muſt provide theſe Things following.

A Grate of Iron of a Foot broad, ſome Bricks, two Pair of good Hand-Bellows, a Pair of Tongs, ſome Lead, Salt-petre, Sandiver,

diver, Borax, *Flanders* Melting-Pots, a Ring of Iron for the Teſt, an Hatchet, or Hand-Saw to cut Wood, ſome good *Aquafortis*, Weights and Scales; and if any Man be not active handed enough, he may have a Man for a Trifle, to ſhew him the manual Practice, in a Day before he go his Voyage.

And for him that will ſearch for dying Stuffs, he may ſee in the laſt Chapter what Things he ſhall ſtand in need of; alſo the other Chapters may be peruſed, whereby every one may be the better accommodated for their ſeveral Enterprizes.

FINIS.

Rara Avis in Terris:

OR THE

Compleat Miner;

In Two Books.

The Firſt containing,

The Liberties, Laws and Cuſtoms of the Lead-Mines, within the Wapentake of *Wirkſworth* in *Derbyſhire*; in fifty-nine Articles, being all that ever was made.

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The Art of dialling and levelling Grooves; a Thing greatly deſired by all Miners; being a Subject never written on before by any.

WITH AN

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By Thomas Houghton.

The Second Edition, Corrected.

LONDON:
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TO ALL MINERS AND Maintainers of MINES,

Within the Wapentake of *Wirkſworth*, or elſewhere:

The AUTHOR wiſheth Happineſs and Proſperity in *LEAD-MINES.*

HOneſt Countrymen, knowing there is nothing extant amongſt you concerning your Liberties, Laws and Cuſtoms ſave only ſome few Written Copies, which thouſands of Miners and Maintainers of Mines have not; nor if they had, would be much the better, by reaſon few can read them: Therefore, that every one that can but read might know the Cuſtoms of the Mines, was the Cauſe I publiſhed this Book, which will much profit, and be a ready Help to all that is concerned in mineral Affairs; in regard you have here in a Vade Mecum, *or* Pocket Companion, *not only the Liberties, Laws and Cuſtoms of the Mines, which all Miners and Maintainers ought to know; but you have alſo ſuch other Things, as are, or may be neceſſary to be*

known

ARTICLE I.

WE ſay upon our Oaths, That by the antient Cuſtom of the *Mines* within the Soak and Wapentake of *Wirkſworth*: The *Miners* and *Merchants* at firſt choſe themſelves an Officer called a *Bar-maſter*, to be an indifferent Perſon betwixt the Lord of the Field, or Farmer, and the *Miners*, and betwixt the Miners and Merchants; which Bar-maſter, upon finding any new Rake or Vein; did (upon notice given by the Miner) deliver to the firſt Finder two Meers of Ground in the ſame Vein; each Meer in a Rape or Pipe-work containing 29 Yards in length, and in a Flat-work 14 Yards ſquare; the which two Meers of Ground the Miner is to have, one for his diligence in finding the Vein, and the other for mineral Right; paying the Bar-maſter or his Deputy one Diſh of his firſt Oar therein gotten; and then the Bar-maſter or his Deputy, is to deliver to the Lord of the Field or Farmer, one Meer of Ground in a new Vein, at either end of the aforeſaid two Meers half a Meer of Ground; and then every one in ſuch Rake or Vein, one Meer, or more, according to their taking.

ARTICLE II.

We ſay if any Miner, or any other Perſon ſet on an old Work, then the Bar-maſter or his Deputy is but to deliver him one Meer of Ground, on either ſide his Shaft half a Meer of Ground; for which of mineral Right he is to pay one Diſh of his firſt Oar therein gotten; and the Lord of the Field, or Farmer, is to have no half Meer in an old Work; but every one is to be ſerved according to his taking.

ARTICLE III.

We ſay that no one ought to ſet on an old Work, or ancient Poſſeſſion, without the Bar-maſter or his Deputy, and one or more of the *Grand Jury*, or Twenty-four, of the Mine.

ARTICLE IV.

We ſay, according to the Cuſtom of the Mines within the Wapentake of *Wirkſworth*, That Grooves, Shafts or Meers of Ground, kept in lawful Poſſeſſion, are an Eſtate of Inheritance, and deſcend to the Heirs and Aſſigns of the Owners; and Wives to have Dowry in them.

ARTICLE V.

We ſay, If any Man (to the knowledge of the Bar-maſter or his Deputy) be lawfully poſſeſs'd of a Meer or Meers of Ground, and does not willingly deſert the ſame, but his *Stows* are gone by ſome ſudden accident, or indirect means, it ſhall not be lawful for any other Perſon to take or poſſeſs ſuch Meer or Meers of Ground, till the Bar-maſter or his Deputy ſet him thereon; and the Bar-maſter or his Deputy, before he ſet any Man on ſuch Meer or Meers of Ground, ſhall firſt take with him one or more of the Grand-jury, or Twenty-four of the Mine; and go to the place where the Poſſeſſion, or Poſſeſſions, or *Stows* ſtood, for ſuch Meer or Meers of Ground, and then make open Publication in the mineral time of the Day, That the Party or Parties whoſe *Stows* ſtood for ſuch Meer or Meers of Ground, are gone, or taken away as aforeſaid, that he or they ſhall (within four Days after ſuch Publication) come, and make good his or their Poſſeſſions for ſuch Meer or Meers of Ground; but if the Party fail to make good his or their Poſſeſſion within four Days after, then the Bar-maſter or his Deputy, and the Grand-jury-men, that was at ſuch Publication, may ſet on any other Man on ſuch Meers of Ground, to work according to cuſtom.

ARTICLE VI.

We ſay that neither the Bar-maſter, nor his Deputy, ought to lay forth or meaſure any Man's Ground, till Oar be gotten in the ſame Ground to free it withal; and when the Ground is freed, it ought to be meaſured and laid forth, and *Meer Stakes ſet the ſame Day.*

ARTICLE VII.

We ſay, that every one ought to keep his Ground in good and lawful Poſſeſſion, with-

Stows and *Timber in Mens ſight*; and that *Croſſes* and *Holes*, without *Stows* and *Timber*, can keep Poſſeſſion but three Days.

ARTICLE VIII.

We ſay, that all Men ought to work their Ground truly, and chaſe their *Stool* to their Grounds end; and ſo each one from Meer to Meer, according to the cuſtom, unleſs they be juſtly hindered by Water, or for want of Wind; and in ſuch Caſes diligence ought to be uſed, to gain Wind, ~~and~~ to get out the Water.

ARTICLE IX.

We ſay, that the Bar-maſter, or his Deputy, ought to walk the Mine once a Week at leaſt, and where he ſees a Meer of Ground which to his knowledge is lawfully poſſeſſed, to ſtand unwrought three Weeks together, and might be wrought, not being hindered by Water, or for want of Wind, then he ought, if he can conveniently, to give notice to the Parties, that neglect to work according to cuſtom; Then he ſhall nick the *Spindle*, each Week a Nick, for three Weeks together; and if it be not wrought within that time, nor borrowed of the Bar-maſter or his Deputy, then within two Days after the laſt two Day of the ſaid three Weeks, the Bar-maſter or his Deputy may lawfully ſet on another Man on ſuch Meer or Meers of Ground, to work according to Cuſtom; and if the Bar-maſter neglect to do his Duty herein, he ſhall forfeit five

Shillings to the Lord of the Field, or Farmer.

ARTICLE X.

We ſay, that if two ſeveral Parties or more ſet Poſſeſſions for one and the ſame thing, claiming for one and the ſame Meer of Ground: Thereupon the Party grieved ſhall complain to the Bar-maſter or his Deputy, who ſhall forthwith bring with him four or more of the Grand-jury or Twenty-four to view the Poſſeſſions, and inform themſelves the beſt way they can, who hath the moſt ancient and lawful Poſſeſſion for that Meer of Ground, and ſhall ſettle the ſame, caſting off the other, and cut out the *Spindle* of ſuch *Stows* as they ſo caſt off: And if the Party whoſe Poſſeſſions they ſo caſt off, think he has wrong thereby, and think he has a good Title to ſuch Meer or Meers of Ground, he may put a new *Spindle* into his *Stows*; and any time within fourteen Days after ſuch caſting off, ſet them on again; thereupon giving the Bar-maſter or his Deputy Four pence, to arreſt ſuch Meer or Meers of Ground, and ſo try his Title: But if he ſet on his *Stows*, and do not arreſt within Fourteen Days after, as aforeſaid, he ſhall incur a fine of Forty Shillings upon his Head for every ſuch Offence; and the Bar-maſter or his Deputy ought forthwith to burn his *Stows*, in the mineral time of the Day: And then if he ſets not on another Pair of *Stows*, and alſo arreſt the next Day after, his Title to ſuch Meer or Meers of Ground ſhall be deemed unlawful, and to have no Plea for the ſame in the *Barmoot-Court*.

ARTICLE XI.

We ſay, that the Lord of the Field, or Farmer, ſhall at all times hereafter provide and keep, between Merchant, Buyer and Seller, a juſt and right *Meaſure* or *Diſh*, according to the ancient Gage, and ſuch a Number of them, as ſhall at all times of the Year conveniently meaſure all ſuch *Lead-Oar* as is got in the *Wapentake* of *Wirkſworth*; and ſuch *Diſhes* ought to be ſeized every quarter of a Year, by the *Brazen-Diſh*, in the preſence of Four or more of the Grand-jury or Twenty-four; and for a Pain every time failing herein, to forfeit 3 s. 4 d.

ARTICLE XII.

We ſay, that by the ſaid *Diſh* or *Meaſure*, the Lord of the Field, or Farmer, is to take his Lot, which is the 13th *Diſh* or *Meaſure*, as it is juſtly and cuſtomarily paid. But we ſay that ſmytham and foreſted Oar hath not (within the Memory of Man) paid, nor ought to pay any Duties, or Part, but *Cope only*.

ARTICLE XIII.

We ſay, that for the Payment of the ſaid Lot, *Miners* within the *Wapentake* of *Wirkſworth*, ought to have Liberty to work the Ground within the *Wapentake*, and to have Timber alſo in the King's *Waſts* to work their Ground withal, and egreſs and regreſs from the Highways to their *Grooves* and *Mines*.

ARTICLE XIV.

We ſay, that the Bar-maſter, or his Deputy, ought to lay forth the *Miners* the next way to the Highway, for going and coming to and from their work, and alſo for carrying to and from their Work, the running Water to waſh their Oar withal.

ARTICLE XV.

We ſay, (by the cuſtom of the Mine) that all Miners and their Servants may waſh their Oar, with Fat and Sieve upon their Works, ſo that they keep their Fats cloſe covered, and empty their Sludge into ſome convenient Place, within their length or quarter Cord, as the Bar-maſter or his Deputy, ſhall appoint, ſo that the Cattle of the Owners or Occupiers of the Land where ſuch waſhing is, may have no harm.

ARTICLE XVI.

We ſay, (By the Cuſtom of the Mine within the *Wapentake* of *Wirkſworth*) 'tis lawful for all the Liege-people of this Nation to dig, delve, ſubvert, mine and turn up all manner of Grounds, Lands, Meadows, Cloſes, Paſtures, Moor or Marſhes for Led-oar, within the ſaid *Wapentake*, of whoſe Inheritance ſoever it is, Dwelling-houſes, High-ways, Orchards, or Gardens excepted; but if any arable Grounds, Lands, or Meadows be digged, delved, ſubverted, or mined, and not wrought lawfully according to the Cuſtom of the Mine, then it may and ſhall be lawful for the Inheritors of the Ground ſo digged, ſubverted, and mined, the ſame to fill up, at their Will and Pleaſure.

ARTICLE XVII.

We ſay, that no Perſon or Perſons ought to keep any counterfeit *Diſh* or *Meaſure* in their Houſes, Coes, or any other Place, to meaſure Oar withal, but every one ought to buy and ſell by the Bar-maſter's lawful *Diſh*, and no other to be uſed or had; and every *Buyer* offending herein, ſhall forfeit for every ſuch Offence Forty Shillings to the Lord of the Field, or *Farmer*; and the *Sellers* thereof ſhall forfeit their Oar, if it be taken at ſuch time.

ARTICLE XVIII.

We ſay, that if any poor *Miner*, or any other poor Perſon, have Oar (under a *Load*) to meaſure, and the Bar-maſter or his Deputy have notice thereof, and do not (upon warning and requeſt) come to meaſure the ſame, then every ſuch Perſon may lawfully take two of his Neighbours, and deliver his Oar to whom he will, ſo that the cuſtomary Duties be paid.

ARTICLE XIX.

We ſay, that the Bar-maſter or his Deputy, ſhall ſee that meaſure be indifferently made betwixt the Buyer and Seller; and the Buyer not to touch the *Diſh*, or to put in his Hand to make meaſure, on pain to forfeit Ten Shillings.

ARTICLE XX.

We ſay, that after the Oar is meaſured, the Merchant, Buyer, or Miner, that carries away the Oar, doth pay to the Lord of the Field, or Farmer, *Cope*, being Six pence of every Load of Oar, nine *Diſhes* to the Load; for the which *Cope*, the Miners or Merchants have Liberty to carry away the Oar, and ſell and diſpoſe of it to whom they pleaſe, to their beſt Advantage, without the diſturbance of any Man.

ARTICLE XXI.

We ſay, that if any Perſon, or Perſons, will make any claim or Title to any Grooves, or Meers of Ground, Rake, Vein, or Oar, he ought to arreſt the ſame, according to the cuſtom of the Mine, and the Defendant ought to be bound in a Bond (with ſufficient Sureties for him to the Plaintiff) to anſwer at the next *Barmoot-Court*, to ſuch Actions as ſhall be brought againſt him, by the Plaintiff, upon the ſaid Arreſtment; and after to yield ſo much Oar, or the value thereof to the Plaintiff, if the Defendant be caſt, by the Verdict of 12 Men; as ſhall be gotten at ſuch Grooves or Meers of Ground, from the time of ſuch Arreſt, till ſuch Trial at the *Barmoot-Court*.

ARTICLE XXII.

We ſay, that after any Arreſt made, the Bar-maſter, or his Deputy, upon requeſt made, ought to appoint a *Court-Barmoot* within ten Days, or as ſoon as he can conveniently: And if the Plaintiff do not purſue his Suit upon the Arreſt, he ſhall then loſe Six Shillings and Eight pence to the Steward; and a Nonſuit ſhall paſs againſt him: And we ſay, that a Nonſuit is to be of the ſame Effect and Validity with a Verdict; and every way to ſignify as much; and if the Defendant fail to make his Defence, a Verdict ſhall paſs againſt him for his Default.

ARTICLE XXIII.

We ſay, whoſoever ſhall be condemned and caſt by a Verdict of 12 Men; or otherwiſe, if a Jury, be ſummon'd and upon calling appear, if the Plaintiff will not go on, and follow his Suit, he ſhall pay Four Shillings for 12 Mens Dinners: And *Pawns* ſhall be put in on both parts, into the Bar-maſter, or his Deputy's Hands, at the time of the Arreſt, or within three Days following.

ARTICLE XXIV.

We ſay that the Defendant ought to have ſix Days time at leaſt, before any Court, to prepare himſelf for his Defence; and what Arreſts are made within ſix Days next before the Court, the Defendant may, if he pleaſe, refuſe to anſwer, and not ſuffer any Loſs thereby; and ſuch Arreſts made within ſix Days, to be void, unleſs both Parties be willing to go on to Tryal.

ARTICLE XXV.

We ſay, that the Bar-maſter, or Steward, ought Yearly to keep two great *Barmoot-Courts* on the Mine, one about *Eaſter*, and the other about *Michaelmas*, within fourteen Days before or after the ſaid times; and every three Weeks a Court, if need be, yearly. If either Plaintiff or Defendant requeſt a Court, he is to keep one within ten Days after ſuch Requeſt, or forfeit Ten Shillings.

ARTICLE XXVI.

We ſay, if any Groove, Shaft, or Meer of Ground be arreſted, all the Oar got or meaſured at ſuch Groove, Shaft, or Meer of Ground, from the Arreſt to the Tryal, is liable to the Arreſt: And if the Verdict be found for the Plaintiff, then the Defendant ſhall pay to him ſo much Oar or the Value thereof, as ſhall appear by Evidence was gotten, or meaſured at ſuch Groove, Shaft, or Meer of Ground, from the time of the Arreſt, till the Tryal: And when the Bar-maſter, or his Deputy, makes ſuch Arreſt, he ought to take good Security for the Oar that is to be meaſured there, or carried away to any other Place.

ARTICLE XXVII.

We ſay, that honeſt and able Men ought to be ſummon'd for Jurors, out of every Diviſion within the *Wapentake*; and to be ſummon'd as near the Court-day as may be; and of every Diviſion ſome to ſerve, unleſs ſome juſt cauſe be ſhewed to the contrary.

ARTICLE XXVIII.

We ſay, that able fit Men, if they be not Miners, if they have Parts and be Maintainers of Mines, and known by the Bar-maſter, or his Deputy, to underſtand well the Cuſtom of the Mine; they ought to ſerve for Jurors, eſpecially in difficult and weighty Matters and Cauſes.

ARTICLE XXIX.

We ſay, that one Verdict for Wages due to Workmen, ſhall fully conclude and determine. And for the Title that ariſeth by Contract, as by Gift, Sale, or Exchange, (or the like) and alſo for right of Poſſeſſion, for Shafts or Meers of Ground; two of the firſt Verdicts for one Party, ſhall fully conclude the Title.

ARTICLE XXX.

We ſay, that when a Verdict is gone for either Party, if he which hath loſt will have another Tryal for the Title, he ought to arreſt within Fourteen Days next after the Court, when the Verdict went againſt him; or elſe that Verdict ſhall determine, and fully exclude him from any further Claim; unleſs that longer time for Workmanſhip be abſolutely neceſſary to diſcover the Truth: If ſo, then the Party grieved may within fourteen Days cauſe four or more of the Grand-jury, or Twenty-four, to view the Work in queſtion; and what time they think fit for Workmanſhip to diſcover the truth; that they may allow, giving ſuch their doings (under their Hands) in writing to the Bar-maſter or his Deputy of that Diviſion: And if it proves the allowed time be too ſhort, then the grieved Party may again procure Four or more of the Grand-jury, or Twenty-four, to view the Work a ſecond Time; and if they then find that Workmanſhip hath been duly made, and yet more time is requiſite, they may give longer time again, in manner as aforeſaid: And then if the Party grieved arreſt not within ten

Days after the time is expired, that Verdict that went againſt him ſhall fully conclude and determine the Title.

ARTICLE XXXI.

We ſay, that no Perſon ought to ſue for Mineral Debt, Oar, Grooves, Treſpaſſes in Grooves, or Grounds in Varience, but only in the *Barmoot-Court*; and if any do the contrary, they ſhall loſe their Debt and Oar for which they are in Controverſy, [and ſhall pay the Charges in Law, and loſe all their Grooves or Meers of Ground, and Parts thereof to the Party grieved, till upon juſt account, he have ſatisfaction for all his Charges and Expences in and about ſuch Suits] to the Lord of the Field or Farmer: Alſo all ſuch as ſue out of the *Barmoot-Court*, as aforeſaid, ought to have no Benefit, nor Plea in *Barmoot-Court*.

ARTICLE XXXII.

We ſay, no Officer ought, for Treſpaſs or Debt, to execute or ſerve any Writ, Warrant, or Precept upon a Miner, being at his Work on the Mine, nor when the Miners come or go to the *Barmoot-Court*, but the Bar-maſter or his Deputy only.

ARTICLE XXXIII.

We ſay, if two ſeveral Parties, or more, be Groove-fellows, or Part-owners to one Groove, or Meer of Ground, and one or more of the Part-owners will not keep Company nor pay his or their proportional Part or Parts of all ſuch Workmanſhip, and other Charges and Expences as are neceſſary and conducing to ſuch Groove or Grooves, Meer or Meers of Ground: Thereupon the Party grieved ſhall complain to the Bar-maſter, or his Deputy, who ſhall take with him two or more of the Grand-jury, or Twenty Four, and ſpeak to the Party or Parties who neglect or refuſe to pay Charges, and keep Company as aforeſaid, and give him or them warning to come in within ten Days to pay Charges and keep Company with their Part-owners; and if (after warning given) the Party or Parties refuſe to pay Charges, or to come in and keep Company as aforeſaid; then the Bar-maſter or his Deputy, and the Grand-jury, or Twenty-four, at their meeting next following (unleſs ſome juſt cauſe be ſhewed to the contrary) may order the Party or Parties, that have refuſed and neglected to pay Charges, and keep Company, that he or they ſhall come and pay Charges, and keep his or their Part-owners: And ſuch order of the Grand-jury, or Twenty-four is to be binding, as though it was at *Barmoot-Court.*

ARTICLE XXXIV.

We ſay, that when a Meer or Meers of Ground are wrought under Water, and by reaſon thereof hath ſtood many Years unwrought, and the Owner or Owners of ſuch Meer or Meers of Ground do not uſe ſome effectual means to get forth the Water, to recover the ſame; and that the ſame might be wrought by the means of a *Sough*, or *Engine*, and that for the public good, but is yet neglected: Thereupon any Perſon or Perſons, who are minded to disburſe and lay forth Money, to recover ſuch Works from Water, may, at a great *Barmoot-Court* held at *Wirkſworth*, declare ſuch their Intentions, in Writing, to the Grand-jury, or Twenty-four, and they ſhall take the ſame into conſideration; and if they know ſuch Works to have ſtood ſo long, by reaſon of Water, and no effectual means uſed to win the ſame; and that the Perſon or Perſons who deſire to undertake to win the ſame by *Soughs*, or otherwiſe, to be able Men, and like to perfect ſuch a Work: Thereupon the Grand-jury, or Twenty-four ſhall appoint a Day (a Month after at leaſt) for themſelves, and the Party that undertakes, and all the Owners of ſuch Works, to meet at the place where ſuch Works are, and this time of meeting ſhall be publiſh'd by the Cryer in the great *Barmoot-Court*, that all Men may take notice thereof. At ſuch meeting the Undertakers ſhall give the Grand-jury, or Twenty-four, to underſtand by what means they intend to lay dry all ſuch Works, and to get out the Water, for recovering the ſame; and if the Grand-jury, or Twenty-four, thereupon conceive the way and means they propoſe is like, and effectual to recover ſuch Work from Water, ſo that the Public may have advantage thereby, the Grand-jury, or Twenty-four, ſhall acquaint the Owners of ſuch Works with the Intentions of the Undertakers, concerning the recovery of ſuch Works from Water, and the way and means they propoſe for the doing of it. And any of the Owners of ſuch Works (if they pleaſe) may joyn with the

Undertakers, paying their proportionable Parts of the Charge of ſuch *Soughs* or *Engines* as ſhall be made to recover the ſame, according to their Parts, and enjoy the Benefit thereof. And ſuch of the Owners of ſuch Works, as ſhall not (by themſelves, or others by their Authority) appear at ſuch Meeting; or then neglect or refuſe to join, and pay their proportionable Part or Parts of Charges of ſuch *Soughs* or *Engines* as ſhall be made and uſed for the Recovery of ſuch Works from Water, as aforeſaid: Thereupon the Grand-jury, or Twenty-four, and Bar-maſter, or his Deputy, ſhall have Power to diſpoſſeſs ſuch Owner or Owners from their Part or Parts, and to aſſign and deliver Poſſeſſion of ſuch Part or Parts to the Undertakers thereof, as aforeſaid; withal, ordering, That the Undertakers of ſuch Works ſhall give to the Owners, that refuſe and neglect, as aforeſaid, ſuch reaſonable Satisfaction as the Grand-jury, or Twenty-four ſhall then think fit. And if it happen, in the carrying on of the Buſineſs for the Recovery of ſuch Water-Works, that any Difference ariſe betwixt the Undertakers and the Owners of ſuch Works, or any of them, ſo that the Work is obſtructed thereby; then the Grand-jury, or Twenty four, being called together, ſhall have Power to regulate all ſuch Difference, whereby the Work may be effectally accompliſhed for publick Good.

ARTICLE XXXV.

We ſay, that when any Man is poſſeſſed of a Groove or Meer of Ground, and hath found the Vein, and works therein, he ought to ſuffer ſer his Neighbour, who is the next taker, and ſhew him the beſt Light and Direction he can, which Way, and upon what Point the Vein goeth: But in caſe any Man be ſo refractory as to deny his Neighbour ſuch a Courteſy, then he may procure three or more of the Grand-jury, or Twenty-four, to be ſummoned, and the Bar-maſter, or his Deputy, may put them into his Groove, who hath the Vein in Work, where they may (by uſing of a Dial, or ſome other Skill) ſhew him that is the next *Taker*, which Way, and upon what Point the Vein goes, ſo that he may know thereby where to ſink his Shaft to find the Vein; that the Field may be ſet forwards for the publick Good; provided always, that ſuch of the Grand-jury, or Twenty-four, as go into the Groove aforeſaid, ſhall not do any other Act or Thing, or make any other Diſcovery of ſuch Groove, ſave only to ſee which Way, and upon what Point the Vein goes.

ARTICLE XXXVI.

We ſay, that where any Man is lawfully poſſeſſed of a Meer of Ground, for any Rake or Vein, and works the ſame truly according to the Cuſtom of the Mine; if any other Man ſhall ſet *Poſſeſſions* at, or near his *Fore-field*; pretending for a croſs Vein, or ſome other Thing; and by Workmanſhip ſhall be ſtrongly ſuſpected to work in the ſame Vein, for which there is another in Poſſeſſion, and truly works the ſame; thereupon the Party grieved may procure the Grand-jury, or Twenty-four, to be ſummoned to appear at the Place in Queſtion; they, or ſo many of them as appear, (being above twelve) ſhall view the whole Work; and if thereupon they find, by their beſt Skill, the *Thing* in all Probability to be one and the ſame; and yet for want of Workmanſhip cannot then plainly appear, then ſuch of the Grand-jury, or Twenty-four, as appear and view, as aforeſaid, ſhall give ſuch their Opinions under their Hands in Writing; withal, ordering who they conceit works wrongfully, forthwith to give the Party grieved good Security for all the Oar got at the Work in Queſtion, till Time and Workmanſhip make the Truth appear; but if the Party who is to give Security, refuſe to give ſuch Security, then ſuch of the Grand-jury, or Twenty-four, as appear and view, as aforeſaid, ſhall (by their Order under their Hands) appoint the Bar-maſter, or his Deputy, to ſeize and ſequeſter all the Oar got at the Work in queſtion, till Workmanſhip do make the Truth appear, to whom the Vein belongs; and when either Party does conceit that Workmanſhip enough is made in it to make the Truth appear, then either of them may procure the Grand-jury, or Twenty-four, to be ſummoned again; and ſuch of them as appear, being above Twelve, ſhall view the Work in Queſtion; if then, by Workmanſhip, it may appear to whom the Oar and Vein belongs, they may order it the ſame Party to whom they conceive it due; and if either Party think he hath wrong thereby, he may arreſt, and have his Trial for his Right or Title,

ARTICLE XXXVII.

We ſay, that no Perſon ſhall come to any Workman that works his Ground truly, upon any Colour or Pretence to claim his Ground, to hinder his Work, or to ſtop the *Field*; but the firſt Workman ſhall only work, and the Claimer arreſt, and take the Law, and the Bar-maſter ſhall do him Law truly.

ARTICLE XXXVIII.

We ſay, if any Vein or Rake go croſs thro' another Rake or Vein, he that comes to the *Pee* firſt ſhall have it, and may work therein, ſo far as he can reach with a *Pick*, or *Hack*, having a helve three Quarters of a Yard long, ſo that he ſtand wholly within his own Cheeks, when he works ſuch a *Pee*.

ARTICLE XXXIX.

We ſay, that when two Veins go together, parted with a Rither, that it is ſcarce diſcernable whether it be two Veins, or but one; in this caſe, ſo long as the Rither may be taken down by firing on the one Side, it is to be taken and reputed but for one Vein; but in Caſe the Rither be ſo thick that it cannot be taken by firing on the one Side, and the Veins go ſo aſunder, for half a Meer in length, then they are ſerviceable to the Miner, as two diſtinct Veins.

ARTICLE XL.

We ſay, that any Miner, in an open Rake, may kindle and light his Fire, after four of the Clock in the afternoon; giving his Neighbour lawful Warning thereof.

ARTICLE XLI.

We ſay, if any Miner, or other Perſon, do under-beat his Neighbour's Meer, and work out of his own length into another Man's Ground, the Party ſo grieved may procure two or more of the Grand-jury, or Twenty-four, to view ſuch a Treſpaſs, and order the Party that hath done the Wrong to give the Party grieved full as much Oar as the Value thereof, as they conceive is gotten wrongfully, without allowing any Charge for getting the ſame; and the Party offending herein ſhall forfeit for every ſuch Offence five Shillings and four pence; which Fine the Bar-maſter, or his Steward ſhall have.

ARTICLE XLII.

We ſay, that if any Miner, or other Perſon doth work, and keep lawful Poſſeſſion of any Groove, Shaft, or Meer of Ground, according to the Cuſtom of the Mine; if any Perſon or Perſons (by Day or Night) caſt in, or fill up ſuch Shaft, Groove, or Meer of Ground, however they ſhall be wrought; every ſuch Perſon offending herein ſhall forfeit for every ſuch Offence ten Pounds, the one half to the Lord of the Field, or Farmer, and the other half to the Bar-maſter, or Steward; and ſhall pay the Party ſo much as will make good the Work again.

ARTICLE XLIII.

We ſay, that if any Perſon or Perſons ſhall at any Time go to any Gentleman, or other Perſon, and give, ſell, or exchange any Part or Parts of a Groove, or Meer of Ground in Variance, for Maintenance; every Perſon ſo offending ſhall thereby loſe his Groove, or Meer of Ground, or Part thereof in Variance; and the Taker or Buyer ſhall forfeit ten Pounds to the Lord of the Field, or Farmer.

ARTICLE XLIV.

We ſay, that if it happen that any Miner be killed, or ſlain, or damped upon the Mine, within any Groove, neither Eſcheator, Coroner, or any other Officer ought to meddle therewith, but the Bar-maſter, or his Deputy.

ARTICLE XLV.

We ſay, that no Perſon ought to bring any unlawful Weapon to the Mine; and for every Rime ſo doing, to forfeit 3 *s.* 4 *d.* to the Steward, or Bar-maſter: And if any make an Aſſault or Fray on the Mine; every ſuch Perſon ought to forfeit for every ſuch Offence 40 *s.* and for every Blood-ſhed againſt the Peace, 5 *s.* the one Half to the Lord of the Field, or Farmer, and the other Half to the Bar-maſter, or Steward.

ARTICLE XLVI.

We ſay, that every Man that hath a Waſh-trough, ought to have ſeven feet about the ſame; and if any Perſon dig, delve, or ſhovel in the ſaid Trough within the ſaid Space, he ſhall forfeit for every ſuch Offence 12 *d.* to the Steward: Alſo we ſay, that no Perſon ought to dig, delve, or ſhovel near any Man's Bing-place, upon pain to forfeit 12 *d.* for every ſuch Offence.

ARTICLE XLVII.

We ſay, that no Perſon or Perſons ought to cave upon any Man's Ground except the Owner be preſent on the Ground, on Pain to forfeit the Oar they get to the Owners of ſuch Ground, if they be taken: And alſo 6 *d.* to the Lord of the Field, or Farmer, ſo often as they ſhall be taken therewith. Alſo, no Purchaſer ought to ſtop him, or any Miner, from any Waſh-trough, at any Time, on pain to forfeit for every ſuch Offence, 12 *d.* to the Lord of the Field, or Farmer: Alſo no Caver ought to purchaſe in any Man's Ground, before eight of the Clock in the Morning, nor after four in the Afternoon, on pain to forfeit for every ſuch Offence, 12 *d.* to the Lord of the Field, or Farmer.

ARTICLE XLVIII.

We ſay, that if any Perſon or Perſons feloniouſly take away any Oar or other Materials from any Groove, Shaft, or Meer of Ground, Houſes, Coes, or ſmilting Houſes, or elſewhere, if it be under the Value of 13 *d.* half-penny; the Bar-maſter, or his Deputy, ſhall puniſh the Offender in the Stocks, or otherwiſe, as is fit for ſuch Offenders to be puniſhed: But if the Oar or other Materials be above 13 *d.* half-penny, we ſay it is Felony.

ARTICLE XLIX.

We ſay, that every Bar-maſter, or his Deputy, ought to have a Pair of Stocks, at ſome convenient Place within his Diviſion; the ſame to be built at the Charges of the Lord of the Field, or Farmer; by the Benefit ariſing out of the Fines; and ſuch Perſons as ſwear, curſe, or commit any other Miſdemeanors on the Mine, fit to be puniſhed in the Stocks; the Bar-maſter, or his Deputy, ſhall puniſh ſuch Offenders, at any Time under the Space of twelve Hours, as the Offence ſhall require.

ARTICLE L.

We ſay, that no Miner ought to be fined or amerced by the Steward of the *Barmoot-Court* for his not appearing there, unleſs he have lawful Warning; but if lawful Warning and Summons be given, and the Miner fail to come and appear, according to Cuſtom, the firſt Time is 2 *d.* and ſo at every Court (if occaſion enſue) is double the ſame, till it come to 5 *s.* 4 *d.* whereof 5 *s.* is due to the Lord of the Field, or Farmer, and 4 *d.* to the Steward: And in Caſe Twenty-four Miners be ſummoned on a Jury, for a Trial betwixt Party and Party, to appear at the *Barmoot-Court*; if there appear not 12 of them, whereby to have a full Jury, then all ſuch as fail in appearing herein, ſhall be fined, as the Bar-maſter or Steward pleaſes, in any ſum not exceeding 10 *s.* provided always, they have lawful Summons, and be able of Body to come.

ARTICLE LI.

We ſay, that if any Groove, Shaft, or Meer of Ground be in Controverſy, and the Grand-jury, or Twenty-four, be called to view that Shaft or Meer of Ground, or to do or perform any other Duty concerning the ſame, and thereupon make an Order, and give their Opinions under their Hands in Writing, concerning ſuch Groove, Shaft, or Meers of Ground in Controverſy: Then ſuch Order, or Opinion, as the Grand-jury, or Twenty-four, or Part of them make, being above four, may and ought to be produced in the *Barmoot-Court* at the Trial, and there openly read, and ſhewed to the Jury, that they may take notice thereof as they think fit.

ARTICLE LII.

We ſay, that if the Grand-jury, or Twenty-four, for the Mine, or Part of them, be (by the Bar-maſter, or his Deputy) called to view any Work within Ground; or to do, or perform any other Office or Duty, concerning theſe, or any other Articles, for the Cuſtom of the Mine; if any Perſon or Perſons reſiſt, or hinder them therein, every one ſo offending ſhall forfeit for every ſuch Offence 5 *l.* the one Half to the Lord of the Field, or Farmer, and the other Half to the Bar-maſter, or Steward; and if any reſiſt the Bar-maſter, or his Deputy, he may, if need be, call any Miners to aſſiſt him, and the Grand-jury, or Twenty-four, or part of them; and if any Miner neglect or refuſe herein, he ſhall forfeit for every ſuch Neglect 5 *s.* to the Lord of the Field, or Farmer.

ARTICLE LIII.

We ſay, that the Bar-maſter, or his Deputy, or the Steward, ought to levy and collect all Fines and Forfeitures, due by Cuſtom of the Mine; and where any Perſon hath not Oar to diſcharge the ſame, and is not otherwiſe able, or willing to pay ſuch Fines and Forfeiture; then the Bar-maſter, or his Deputy, ſhall (for every ſuch Offence) puniſh every ſuch Perſon in the Stocks, to ſit there twelve Hours pining, with a Paper on his Back, ſhewing for what Offence he ſits there; but in caſe the Bar-maſter, or his Deputy, or the Steward, do not henceforth levy and collect all Fines and Forfeitures, due by the Cuſtom of the Mine, nor puniſh ſuch Offenders in the Stocks, as are fit to be puniſhed; they ſhall forfeit for every ſuch Neglect 5*s.* to the Lord of the Field, or Farmer.

ARTICLE LIV.

We ſay, if any Miner or Miners, or any other Perſon or Perſons, be poſſeſſed of a Meer or Meers of Ground, or Part or Parts thereof, and work it truly, according to the Cuſtom of the Mine; if there be any Perſon or Perſons that ſhall or will make Claim or Title to the ſame, or any Part thereof; that he or they ſhall come and make their Claims (either by themſelves, or by ſome Agent employed by them) before the Bar-maſter, or his Deputy; and within ſix Months after the ſame ſhall be in Workmanſhip; and if denied of what he or they ſhall claim, he or they muſt arreſt within fourteen Days after the ſaid

Claim and Denial, or elſe his or their Title ſhall be deemed unlawful, and to have no Plea for it in the *Barmoot-Court*.

ARTICLE LV.

We ſay, whereas we find by daily Experience, that great Abuſes, and many Inconveniences do ariſe, by Perſons taking Part on both Sides, and only putting in their *Pawns*, and will neither maintain with Plaintiff nor Defendant of their neceſſary Charges; and they ſo refuſing to pay, poor Men are many Times utterly undone and overthrown. Whereupon we order and agree, (that where any Controverſy ſhall happen about any Groove or Grooves, Meer or Meers of Ground in Queſtion) where ſuch Suit ariſeth, if any Perſon or Perſons claim any particular Part or Parts of a Meer of Ground in Queſtion, where ſuch Suits ariſeth; if any Perſon or Perſons make Claim on both Sides, and would only defend his or their Part or Parts, by putting in his or their Part or Parts of *Pawns* on both Sides. We ſay, that it ſhall not be ſufficient for any Perſon or Perſons to defend his or their Part or Parts by ſuch Means only; but he or they muſt either take to the Plaintiff or Defendant, to defend his or their Part or Parts, according to the Cuſtom of the Mine; that is to ſay, he ſhall pay his or their Part or Parts of Charges, as ſhall be needful to make the Truth appear, in trying of the Cauſe or Cauſes, as well as putting in their Part or Parts of the 4 *s.* 6 *d.* for the *Pawn* or *Pawns*; and Charges being lawfully demanded of ſuch, before the Bar-maſter of the Liberty, and one or more of the Grand-jury, or Twenty-four; if the Party or Parties of whom Expences in ſuch Suits and Trials is demanded, as aforeſaid, do not pay the ſame Charge within four Days after it is lawfully demanded; then ſuch Party or Parties, refuſing or neglecting to pay the ſame after ſuch Demands, ſhall forfeit his or their Part or Parts to the Parties grieved, to be equally divided amongſt them, according to their proportionable Parts.

ARTICLE LVI.

We do order and ſay, that if any Perſon that works for Wages at any Groove, or Grooves, Shaft or Shafts, Meer or Meers of Ground, within the ſaid *Soak* and *Wapentake*, and ſhall have his or their Wages wrongfully detained or with-held from him or them, by the Owner or Owner's Servant, or Agents, at any of the ſaid Grooves, Shaft or Shafts, Meer or Meers of Ground; that then, if ſuch Perſon or Perſons, from whom ſuch Wages ſhall be due, or from his or their Servants or Agents employed to manage their Mines, do not well and truly pay ſuch Wages as ſhall be due to any Workman or Servant, within ten Days after an Account given, and Demand made of ſuch Perſon or Perſons Servant or Agents; that then in ſuch Caſe, the Workman or Servant who ſhall be behind in Arrear, and unpaid, as aforeſaid, may arreſt, where ſuch Work was done, or elſewhere, within the ſaid *Soak* and *Wapentake*, his or their Part or Parts of *Oar*, or other Material, where ſuch Perſon or Perſons Servant or Agent (doth not pay as aforeſaid) are concerned, or have any

Part or Parts thereof, and ſo bring it to Trial at the next *Barmoot-Court*; and if ſuch Perſon or Perſons, Servants or Agents, Defendant or Defendants ſhall be caſt, and condemned by the Verdict of 12 Men; then ſuch Defendant or Defendants ſhall pay all ſuch Wages forthwith, which ſhall be given in Damage, and 10 *s.* over and beſides, for and towards the Coſts of ſuch Workmen or Servants, Plaintiff or Plaintiffs, in the Recovery of ſuch juſt Wages, if their Oar be ſufficient under Arreſt to defray the ſaid Charge; but if not, and ſuch Defendant or Defendants refuſe and neglect ſtill to pay ſuch Wages and Charges, as aforeſaid; then the Bar-maſter of the Liberty where the ſaid Defendants have any Grooves, ſhall have power to levy the ſame by Diſtreſs and Sale of the Defendant or Defendants Oar, or Mineral Materials, if any; or otherwiſe, he ſhall deliver all his or their Grooves, or Parts thereof, to the Plaintiff, to work until the Coſt and Damages be fully paid, with all Charges in working the ſame: And the Bar-maſter ſhall not neglect this preſent *Article*, on pain to forfeit (to the King, or his Farmer) 5 *s.* 4 *d.* and to the Party grieved 5 *s.* And if the Defendant or Defendants ſhall contemn or diſobey this *Article*, or hinder the Bar-maſter in the Diſcharge of his Duty, that then every ſuch Offender ſhall forfeit for every ſuch Offence 20 *s.* to the King's Majeſty, or to his Farmer.

ARTICLE LVII.

Alſo we order and ſay, that from henceforth, when any Perſon or Perſons ſhall complain at any great *Barmoot-Court*, for want of Company and Charges, that ſuch Complainants ſhall have a juſt Bill of Charges (if ſuch can be had) annexed to the Bill of Complaint, which the Twenty-four ſhall have Power to determine: Or, at leaſt, he or they ſhall declare upon his or their Oaths to the Grand-jury, or Twenty four, the groſs Sum or Sums of Money, at ſuch Groove or Grooves where ſuch Part-owners are complained againſt, for Want of Company and Charges, as the ſaid Part-owners ſhall be behind and in Arrear; which Sum or Sums ſhall be ſet down in the Order or Verdict of the Grand-jury, or Twenty-four; and if ſuch Sum or Sums be not paid into the reſpective Bar-maſter's Hands (for the Uſe of the ſaid Complainants) within ten Days after Warning given them; then the Bar-maſter may and ſhall deliver Poſſeſſion, according to the ſaid Order: But if the Perſon or Perſons complained againſt, or their Agents, be not reſident within the *Soak* and *Wapentake* of *Wirkſworth*, or if upon diligent Enquiry made by the Bar-maſter, within twenty Days after the ſaid Order to him delivered, that ſuch Perſon or Perſons cannot be found to be reſident, nor his Agents, as aforeſaid; that then in ſuch Caſe, the Bar-maſter may take with him one or more of the Grand-jury, or Twenty-four, and go to the Groove or Grooves, Meer or Meers of Ground, where ſuch Company and Charges are wanting; and there in the Mineral Time of the Day, openly declare, That ſuch Perſon or Perſons ſhall come in, and keep Company, and pay ſuch Charges, as is contained in the ſaid Order, within ten Days after, or loſe his or their

Part or Parts. And if ſuch Charges be not paid according to the ſaid Order, then the Bar-maſter, or his Deputy, may, and ſhall deliver Poſſeſſion, according to the ſaid Order, to the ſaid Complainants: And the Bar-maſter ſhall not neglect his Duty herein, on pain to forfeit 10 *s.* to the King, or his Farmer.

ARTICLE LVIII.

We ſay, that no Perſon or Perſons ſhall let, hinder, or deny the Bar-maſter and Twenty-four, or any of them, by Firing, or any other Ways or Means whatſoever, from going into any of their Grooves, Shaft or Shafts, Meer or Meers of Ground, to view and ſee whether any Wrong or Treſpaſs be committed between Party or Party: Nor for plumming and dialling in any of their Grooves, Shafts, or Meers of Ground, for the End, and ſetting ſtreight of Matters in Controverſy, on pain of every one ſo offending to forfeit for every ſuch Offence 40 *s.* of good and lawful *Engliſh* Money, whereof 20 to the King's Majeſty, or his Farmer, and the other 20 to the Party wronged or grieved; provided always, that the Bar-maſter and Twenty-four, or any two or more of them, come at lawful and convenient Times of the Day.

ARTICLE LIX.

The Grand-jury or Twenty-four for the Body of the Mine, do order and ſay, that from henceforth, every Miner and Maintainer of Mines, within the *Soak* and *Wapentake* of *Wirkſworth*, ſhall prefer their Bills of Complaint at every great *Barmoot-Court* againſt their Part-owner or Part-owners, Groovefellow, or Groove-fellows, in open Court, during the Time of the Steward's ſitting, and not after any Adjournment; to the End that every Perſon concerned, or againſt whom any Bill is preferred, may have legal Proceedings, in open Court, according to the Cuſtom of the Mine.

The End of the Firſt Book.

BOOK II.

The Form of a Bill of Complaint, put up at the Great *Barmoot-Court* held at *Wirkſworth*, April 12, 1681.

JOhn Woodhave, *and his Groove-Fellows, complain themſelves to this Court, againſt* William Holdfaſt *and* Robert Non-pay, *or any one that claims under them, or either of them, for not coming in and keeping Company at the Old Man's Groove, on the Cole-hills, in the Pens Rake, being within the Liberty of* Wirkſworth, *and Juriſdiction of this Court; and for not paying the Sum of* 4 l. *which is due for them to pay; being* 40 s. *a piece for either of their eight Parts to pay; And therefore prays relief.*

The Form of a Croſs Bill, at the ſame Court.

At the Great *Barmoot-Court* held at *Wirkſworth*, for the Soak and Wapentake of *Wirkſworth*, April 12, 1681.

Whereas, John Woodhave, *and his Groove-Fellows, have complained themſelves to this Court, againſt* William Holdfaſt, *and* Robert Non-pay, *or any that claims under them, or* *either of them, for not coming in and keeping Company with them at the Old Man's Groove on the Cole-hills, being within the Liberty of* Wirkſworth, *and juriſdiction of this Court, and for not paying the Sum of* 4 l. *which they ſay is due for them to pay, being* 40 s. *apiece for either of our eight parts: We the aforeſaid* William Holdfaſt *and* Robert Non-pay, *do hereby declare to prove the Payment of the aforeſaid* 4 l. *being* 40 s. *for either of our eight Parts: And therefore pray to be diſmiſt.*

At the Great *Barmoot-Court* held at *Wirkſworth*, April, 12. 1681.

The Names of the Jurors, and their Verdict upon the aforeſaid Bill.

William Stone.
Henry Stafford.
Adam Bell.
Clement Clough.
Thomas Twigg.
John Hill.
Anthony Wood.
William Ward.
Robert Stand.
William Winkat.
Henry Neerheed.
Joſeph Knowſnot.
Robert Letſlip.
William Gaſtby.
Adam Smoker.
Thomas Shepphard.
Anthony Long.
Richard Short.
Gervis Standby.
John Hanger.
Abraham Woodwit.
Samuel Wagſtaffe.
Elias Pool.
Martin Spencer.

We the ſaid Jurors, being elected, ſworn and charged, do (upon Our Oaths) order and ſay, That William Holdfaſt, *and* Robert Non-pay, *or any one that claims under them, or either of them, ſhall come in and keep Company with* John Woodhave, *and his Groove-Fellows; and* *ſhall pay the ſum of* 4 l. *being* 40 s *apiece for either of their eight Parts to pay, which they are behind and in Arrear, at the Old Man's Groove, on the Cole-hills, being within the Liberty of* Wirſtſworth *and Juriſdiction of this Court, within ten Days after lawful Warning given, or Publication made, according to the Article, or loſe their parts.*

Then you muſt return the Croſs-Bill *Ignoramus.*

The Form a Bill made at the ſmall *Court-Barmoot*, for tryal of Titles.

At the ſmall *Court-Barmoot* held at —— the 13th Day of *April*, 1681.

Edward Wood, *and his Groove-Fellows, complain themſelves to this Court, againſt* James Wilde, *and his Groove-Fellows, for unjuſtly entering into, and detaining from the Complainants one Founder Meer of Ground in a Groſs rake, diſcovered out of the great White Rake, within the Liberty of* Crumford, *and Juriſdiction, of this Court (on* Crumford-Moor*) and alſo one Firſt Taker Meer of Ground Eaſtward, or a Poſſeſſion for a Firſt-Taker Meer; and for getting therein, and carrying away, One Thouſand Loads of the Plaintiff's* Lead Oar, *and converting it to the Defendants own uſe, to the Plaintiff's Damage of a Thouſand and Fifty Pounds; And thereupon they bring their Suit, and crave relief.*

The Defendants appear and plead the ſix Months Article in Bar.

Jurors Names *B. D. A. B. F. T.*
E. W. R. C. A. T.
A. H. J. H. T. R.
H. C. T. P. W. F.

Verdict. We the ſaid Jurors being elected ſworn and charged to ſay the Truth in the Premiſes, upon our Oaths ſay, That the Defendants are not guilty of entering into and detaining from the Complainants, one Founder-meer of Ground in a Croſs-Rake, diſcovered out of the great White Rake, within the Liberty of *Crumford*, and Jurisdiction of this Court; (on *Crumford* Moor) nor for entering into one Firſt taker meer Eaſtward, as in the Bill is ſet forth. Therefore (according to ſeveral Cuſtoms and Articles uſed within the ſaid Soak and Wapentake) upon our Oaths do further ſay, That the Complainants ſhall pay 4s. for 12 Men's Dinners, &c.

The Form of a Bill put to the Twenty-four, when called to view a Mine in queſtion.

William Fainwood, *and* John Haveall, *and their Groove Fellows to the Grand-jury, or Twenty-four, for the Soak and Wapentake of* Wirkſworth; *being called to the Gang-Rake, on* Middletown-*moor, within the Liberty of* Middletown *aforeſaid, the* 16*th* of April 1681

You are deſired to go down at the Hedge ſhaft, and ſo through the Drift, and down the Turn, and then through the Drift at the Turnfoot, and ſo through the King's half Meer, then through the hole at the Rither Point into *Bates* work, and ſo up his Turn and Shaft to the Day, and to give your opinions, whether it be not all one and the ſame Vein.

Then as many as judge it to be one and the ſame Vein, write their Opinion, if they exceed 12.

Some EXAMPLES *of* DIALLING.

HAving provided your ſelf of a *Dial* in a ſquare Box, or a long ſquare Box, which is better; and alſo of a two foot Rule; and a ſtring or Cord with a Plummet as the end; ſuppoſe you be deſired, or (to try your own Skill) would know the exact depth of a Hading Shaft and Turn, and how far they are driven in that Meer of Ground to an Inch. Firſt cauſe ſome one to go down the Shaft, then let your Cord or String down after him as far as you can, till it touch ſomewhere on the ſide, obſerving the moſt convenient place at the *Stows*, where the String will go down deepeſt and not touch the ſides, and where the Plummet touches the ſide, bid him make a mark at the end thereof; Then the String hanging there, apply the ſide of your Dial thereto, as near croſſing the Rake as you can judge by the handing below, and obſerve what Point the Needle ſtands on, which here you may ſuppoſe to be 52. and this point you muſt keep for your ſquare; then pull up the String, and meaſure it, and ſet the length thereof down in Rules and Inches, under which the word *Depth*, as you may ſee in the Example following, which you may ſuppoſe here to be 24 Rules, and Inches 00; which when you have ſet down, and the point 52 directly over againſt it; then go down to the place where he made the mark in the Shaft, and becauſe your Shaft hades, put one end of your Rule to the place where he made the mark, and lay the Rule croſs into the Shaft; then apply your *Dial* to the edge of the Rule, and wave the *Dial* and Rule up and down together till you ſee the Needle ſtand upon 52, your ſquare point; then from the moſt convenient place of your Rule (whether it be at the end, or in the middle, where the Cord will go down the deepeſt and not touch the ſides) there hold the Cord, and where it touches the ſide at the end below, there bid him make a mark; then (obſerving what Inches lies againſt at the Rule, as here at 22) pull up the Cord, and meaſure the length thereof, from the Rule to the mark below; not forgetting to hold your finger faſt upon the Cord, which you may ſuppoſe to be 16 Rules; which (becauſe you are plumming) muſt be ſet down under *Depth*; Then, having ſet down your point 52, and the 22 Inches in their reſpective places, as in the Example following appears, go down to the place where he made the laſt Mark; and putting one end of your Rule thereto, lay the other into the Shaft, and apply your *Dial* to the edge of the Rule, and wave them up and down together as you did before, till you ſee the Needle ſtand upon 52, the Rule and *Dial* lying cloſe together, let down your Cord as far as you can, till the Plummet touch the ſide below, holding the String at the middle or end of the Rule, or where you ſee it will go down deepeſt, and not hang on the ſides; then bid him make a mark below, where the Plummet touches the ſide; which done, pull up the Cord and meaſure the Length, firſt obſerving at what Inches of the Rule you held it; and ſo ſet down your *Depth*, *Point*, and *Length* in their right places, which here you may ſuppoſe to be 26 Rules and 14 Inches, point 52, and the croſs Length taken thereon, 1 Rule and two Inches: Then go down to the mark he laſt made, and putting one end of the Rule therein, lay the other croſs, as before, and apply the ſide of the *Dial* to the edge of the Rule, and wave them up and down till the Needle ſtands on 52; then let down the String on the Shaft foot, and bid him make a mark below, obſerving that the String touches no where on the ſides, betwixt you and the mark he makes at the Shaft foot; ſo obſerving what Inch the String lies at againſt at the Rule, pull it up and meaſure it, how-many Rules it is, which you may ſuppoſe here to be 28 Rules and 22 Inches, which ſet down, and the point 52, and alſo the number of Inches where the String lies upon the Rule, which here is 18 Inches; and ſo you have finiſhed the Shaft: Then going down to the Shaft foot, hold the *Dial* where the Mark was made, and ſet the Needle upon 52; and if there be any occaſion to take a ſhort croſs length, whereby to give you better liberty to take a long length in the drift; then take the ſhort length, the Needle ſtanding upon 52, apply the String parallel to the ſide of the *Dial*; and having made a mark at the End of the ſhort Length, meaſure how many Rules and Inches it is, (and ſet it down) which you may ſuppoſe here 1 Rule and 10 Inches: then ſet down the Point directly againſt it, by which you took that length as 52; which done, give him that is with you, the End of the String, and let him go back into the Drift as far as he can, till the String begins to touch ſomewhere on the Side of the Middle, and then holding one End of the String in the Mark you made, when you took the ſhort Length; obſerve that the String touches no where betwixt him and you; then apply the Side of your *Dial* to the String, taking notice that the *Dial* and String lie ſtreight one with another, and ſo take the point the Needle ſtands on, which here you may ſuppoſe to be 36; then let him that is at the other End, either make a Mark on the Side, or drop a Stone to the Sole of the Drift, as you find Occaſion; which done, draw the String back, and meaſure it, and ſet the Length thereof down in Rules and Inches, which you may here ſuppoſe to be 22 Rules and 8 Inches, and overagainſt it the Point 36: Then go to the Place where he dropt the Stone or made the Mark, and laying the Rule or String croſs, one End being in the Mark, take a ſhort Length [as you find Occaſion] ſetting the Needle upon 52; which done, ſet down the Point, and this ſhort Length overagainſt it, which here you may ſuppoſe to be 10 Inches: having ſo done, and made a Mark, or dropt a Plum at the End of theſe 10 Inches, this ſhort Length will give you Liberty to take a long Length forwards in the Drift: So let him take the String, and go as far backwards as he can 'till the String almoſt touches ſomewhere in the Middle on the Side; then (holding one End in the Mark you laſt made, when you took the ſhort length) ſtretch the String ſtreight, and apply the Side of the *Dial* to the String, and take the Point the Needle ſtands on, which here you may ſuppoſe to be 36; ſo ſet down the Point, and bid him make a Mark at the End; then pull back the String and Meaſure it, ſetting down the length directly againſt the Point you laſt took, which you may here ſuppoſe to be 24 Rules and 14 Inches; and that to reach to the Turn-head. So being now come to the Turn-head, you muſt fall to plumming again.

Therefore ſet the Needle upon 52, your old Square, and if there be any need, to take a ſhort length, whereby to give you liberty to plum the deeper in the Turn, then you muſt take it; ſo bidding him go down the Turn, let the String down after him, and where it touches on the Side let him make a Mark; you holding one End of your Rule in the Mark that was made at the Turn-head, lay the Edge of the Rule to the Side of the *Dial*, and wave them together till the Needle ſtands upon 52; then ſet down that ſhort Length, which you may here ſuppoſe to be 8 Inches, and pull up the String and meaſure it; which you may here ſuppoſe to be 28 Rules and 6 Inches; ſet it down, and the Point 52 alſo; which done, go down to the Mark he made; and becauſe the Turn hades, put one End of the Rule in the Mark, and lay the other croſs into the Turn; ſo put the Side of the *Dial* to the Edge of the Rule, and wave them together, till the Needle ſtands upon 52: Then let the String down to the Turn-foot; if it will not touch the Sides betwixt the Turn-foot and you; ſo holding the String at the End of the Rule, ſet down this ſhort Length, which is 1 Rule, and the Point 52; and bidding him make a Mark at the Turn-foot, meaſure the Length, which you may here ſuppoſe to be 30 Rules and 2 Inches; And ſo you have plummed the Turn.

If you have any further to Dial, obſerve to take your ſquare point, where there is this Occaſion; for if you omit taking your Square you will loſe yourſelf in the Exactneſs of the Grounds Length, ſometimes making it more, and ſometimes leſs then really it is, and ſo commit great Error, when you come to dial it above Ground: You muſt alſo take Care that you hold your Rule level, when you take your croſs Lengths, and alſo your String when you take Lengths in Drifts; and by that Means you will have the exact Depth: You muſt alſo obſerve that your Rule and String lie parrallel with the Edge of your *Dial*, that is, equally at both Ends; or elſe you will miſs in taking the true Point. Under Ground the *Dial* is guided by the String; but above Ground the String is guided by the *Dial*.

EXAMPLE.

Depth.		*Points.*	*Length.*	
Ru.	*Inch.*		*Ru.*	*Inch.*
24.	00.	52.	00.	00.
16.	00.	52.	00.	22.
26.	14.	52.	01.	02.
28.	22.	52.	00.	18.
00.	00.	52.	01.	10.
00.	00.	36.	22.	08.
00.	00.	52.	00.	10.
00.	00.	36.	24.	14.
28:	06.	52.	00.	08.
30.	02.	52.	01.	00.

That is 152 *Ru.* 44 *Inch.*

And the Rule containing 2 Foot, it makes in all 307 Foot and 8 Inches for the Depth of the Shaft and Turn; which by Reduction makes 51 Fathoms, 1 Foot and 8 Inches, for the true Depth of that Mine.

Example.

44 Inches make 3 Foot 8 Inches; which ſet below the 304; and added makes $307\frac{08}{12}$.

add 152.
152.

Sum in ſingle 304. *Foot.*
$3\frac{08}{12}$. *add.*

307. *Foot.*

Now, if you would know how much your Shaft and and Turn haded, you muſt add up the Lengths that ſtand againſt your Square-point 52. As for Example.

Rules.	*Inches.*
00	22.
01.	02.
00.	18.
01.	10.
00.	10.
00.	08.
01.	00.

Rules 03. 70. *Inches.*

Which by Reduction makes 11 Foot and 10 Inches; and ſo much your Shaft and Turn hades. To know the exact Length you have driven in your Ground, without laying it forth above, you muſt add up the Rules and Inches that ſtands under the Word *Length*, againſt your by-points; which in this Example is
only *Rules* 22. and 8. *Inches.*
and 24. and 14.

That is, *Rules* 46. and 22 *Inches.*

Which by Reduction is 93 Foot and 10 Inches; which makes 31 Yards 10 Inches you have driven; but if you are to dial and lay it out above Ground, ſet the *Dial* upon the Point 52; and looking in your Note for 22 Inches, which was the firſt Length; put one End of the Rule to the Place of the *Stows* where you held the String when you began to plum the Shaft; the Rule lying to the Side of the *Dial*, and the Needle ſtanding upon 52, make a Mark at 22 Inches upon the Ground; and ſo you have done the firſt Point: And in like Manner you muſt do all the Reſt, if you go over theſe Points ſingly, one by one; but becauſe here is ſeveral ſquare Points before you come to any by-point, that goes as the Rake goes; therefore you may take all theſe ſquare Points together, firſt adding their Lengths up, and knowing how many Rules and Inches they make: As for Example.

	Ru.	*Inch.*
The firſt Point is	00.	22.
The ſecond Point is	01.	02.
The third Point is	00.	18.
The fourth Point is	01.	10.
Sum is	2.	52.

Which by Reduction makes 4 Rules and 4 Inches; that is, 3 Yards wanting 8 Inches, and ſo much your Shaft hades; therefore if you firſt meaſure out ſo much upon your Cord, and hold one End at the ſame Place on the *Stows*, and give him the other End to go forwards with; then the Side of the Dial lying ſtreight with the String, and the Needle ſtanding upon 52, bid him make a Mark there and ſo you have taken all the 4 Points togethe and found the Mark above Ground, which I made at the Shaft-foot: Then go to the Ma be made, and looking in your Note, what yo next Length is, (which is 22 Rule and 8 Inches) meaſuring out ſo much upon your Cord; let him go forwards with one End, and Cauſe ſome one to hold the other End in the Mark he laſt made; then look in your Note for your Point overagainſt that Length, which is 36; ſo ſetting the Needle upon 36, let him that has the Plummet-end bring the Cord to the Side of the *Dial*, you ſtanding ſome diſtance from him that holds the other End in the Mark: Then (the Cord lying exactly even with the Side of the *Dial*, and the Needle ſtanding upon 36) bid him make a Mark at the End of the Plummet; and ſo you have done that Length; go then to your laſt Mark and put one End of your Rule in it, and ſet the Needle upon 52, laying the Edge of the Rule to the *Dial*, the Length being but 10 Inches, make a Mark there; then look in your Note for your next Lengths which is 24 Rules and 14 Inches; which meaſure out, and let him go on with the String, cauſing the other End to be held in the laſt Mark; and ſetting the Needle upon 36, the Point over-againſt that Length, bid him wave the Cord up and down till it lies exactly ſtreight with the Side of the *Dial*; then bid him make a Mark; ſo you have done that Length. Laſtly, becauſe the other 2 Lengths are both to be taken upon one Point, and there being no other by-point betwixt them, therefore you may add the Lengths together (and take them at once) which is 1 Rule and 8 Inches, the Needle ſtanding upon 52; the End hereof is the Place above Ground directly over the Mark you made at the Turn-foot.

Now, to know whether you have dialled this exactly or no (without going over it again) firſt add all your ſquare Lengths together: as for Example.

	Ru.	*Inch.*
	00.	22.
	01.	02.
	00.	18.
	01.	10.
	00.	10.
	00.	08.
	01.	00.
Sum is	5.	22.

Which converted into Feet makes 11 Foot 10 Inches; and ſo much your Shaft and Turn hades and declines from the Place you firſt begun to plum at the *Stows*: Then add up the Lengths you took Rake-ways, which was only 22. *Ru.* 08. *Inch.*

and 24. 14.

46. 22.

Which by Reduction is 93 Foot and 10 Inches, or 31 Yards and 10 Inches: ſo taking your Rule and Meaſuring out the 46 Rules and 22 Inches; give him the Plummet-end to go Rake-ways, cauſing ſome one to hold the other End at the Place on the *Stows* where you firſt began to plum; then go you to the Middle of the String, and ſetting the Needle upon 36, bid him wave it up and down, till you ſee the String lie exactly ſtreight with the Side of the *Dial*, then bid him make a Mark at the End: go to this Mark, and meaſure out your ſquare Length, which in all was 5 Rules and 22 Inches; give him the End, holding the other End in the Mark, ſet the Needle upon 52, bid him wave the ſtring up and down, till it lie parrallel with the Box: Then bid him make a Mark. And if this Mark hit the Mark you made when you Dialled it before, you have done the Work exactly, or elſe you have committed ſome Error.

Note, This ~~Rule always holds true~~; when you take ſquare Lengths, and your Lengths forward, Rake-ways, or any ways, by one point: As here you took by the Point 36.

How to plum Shafts and Turns that hade, and beat into the End.

FIrſt, let down your Cord as far as you can, holding it at the moſt convenient Place on the *Stows*, where it will go down deepeſt; and where the end touches below bid him make a Mark: Then apply your *Dial* to the ſide of the Cord, (whilſt it hangs there) and take that Point you judge to be the neareſt croſſing the Rake for your ſquare Point, which here you may ſuppoſe to be 48; ſet the Point down, pull up the String and meaſure it, which ſuppoſe here to be 26 Rules and 8 Inches; ſet them down: Then go down to the Mark he made, put one end of the Rule therein, laying the other croſs into the Shaft, apply the *Dial* to the edge of the Rule, the Needle ſtanding upon 48, let down the Cord, (which by reaſon that the Shaft beats much one way, the Plummet will fall upon the end) and where it touches the end bid him make a Mark, obſerving what Inches of the Rule you hold the String at; which ſuppoſe here to be 18; ſet them down, and the Point 48 alſo; then go down to the Mark he made at the end of the Shaft, and putting one end of your Rule or String (whether you find more convenient) in that Mark, lay out the other end towards the other end of the Shaft, and take the neareſt ſquare Point you can to 48; which here ſuppoſe to be 32; make a Mark at the end of the String, in the other end of the Shaft, if you take it quite through; but if you take it half way by the Rule, then perhaps the Rule may touch the lying ſide, and then you muſt make a Mark there, the Needle ſtanding upon 32, and ſet down the length taken upon that Point; and ſo afterwards take a croſs length from that Mark upon your ſquare 48; but if you take it quite through the Shaft, to give more Liberty to plum deeper the next time; then meaſuring it, ſet down the Length, and the point 32 overagainſt it, which here you may ſuppoſe to be 2 Rules and 8 Inches; which done, hold one end of the String in that Mark you made in the end of the Shaft, and let down the Cord as far as you can, till it either touch the ſide or the end of the Shaft; which here you may ſuppoſe to touch both end and ſide in the corner of the Shaft: bid him make a Mark there:

Then pull up the Cord, and meaſuring it, ſet it down under *Depth*, which you may ſuppoſe to be 8 Rules and 10 Inches: And here you are to take no Point, this being only a Plum: Then go down to the Mark, and put one end of the Rule therein, and lay the other againſt the *Wough*, lengthways of the Shaft, and apply the *Dial* to the ſide of the Rule, the Needle ſtanding upon 52, make a Mark at the end of your Rule, or where you ſee moſt convenient; ſo counting the Inches, ſet them down and the Point 32, which here ſuppoſe to be 23 Inches: But if it chance, when your Rule lies to the *Wough*, you cannot take the Point 32 exactly; In ſuch caſe, put the end of the Rule 3 or 4 Inches, more or leſs as you ſee convenient, towards the hanging ſide, but be ſure it be level with the ſame Mark, and then ſet down ſo many Inches for a length as you judge it to be, and over-againſt the ſquare Point 48: Or if it happen that the *Wough* flies back, ſo that the Rule needs not touch it, yet keep the Rule and *Dial* together, the Needle ſtanding upon 32, ſet down that length you think moſt convenient to take, and then fall to plumming again: And if your Plummet falls upon the end of the Shaft, or upon both ends and ſide as before, yet take your length upon the Point 32, by help of either of thoſe ways you laſt took it; that is to ſay, by ſhifting your Rule or String ſomething nearer the hanging ſide, taking care to ſet down thoſe Inches you ſo allow againſt your ſquare Point: But if it falls upon the ſide, and the Shaft hath left off under-beating, and goes ſtreight, only hades, then lay your Rule croſs into the Shaft, and take your length upon the ſquare Point 48, till you have finiſhed plumming the Shaft: So by obſerving theſe Directions well you may exactly Plum and meaſure to an Inch, any Shafts, Turns, Lobs or Stumps, that either hade, or hade and underbeat.

The Table of the foregoing Operation.

Depth.		*Points.*	*Length.*	
Ru.	*Inch.*		*Ru.*	*Inch.*
26	08	48	00	00
12	10	48	00	18
00	00	32	02	08
08	10	00	00	00
00	00	32	00	23

Sum 46 Ru. 28 Inch.

Which converted into Feet makes 94 Foot and 4 Inches; for you muſt obſerve, that the 28 Inches, is equal to 1 Rule and 4 Inches, or 2 Foot 4 Inches: So if you divide 94 Foot and 4 Inches by 6, the Number of Feet in a Fathom, you will find the Shaft to be 15 Fathoms, 4 Foot and 4 Inches deep: Now if you would know how much the Shaft hades and under-beats, and would find the Place above-ground where you made the Mark la below; Firſt, add the Lengths together y took upon your ſquare Point 48; which was only 18 Inches: Then putting one of the Rule to that Place of the *Stows* where firſt began to plum, lay the *Dial* to the Side of the Rule, the Needle ſtanding upon 48, make a Mark there: Then add together the Lengths you took upon the Point 32, which makes 3 Rules and 7 Inches; meaſure out ſo much, holding one End in the laſt Mark, let him go forwards with the other, ſet the Needle upon 32, the String lying ſtreight with the Side of the *Dial*, bid him make a Mark there, and this is the exact Place above-ground right over that where you made the Mark laſt below.

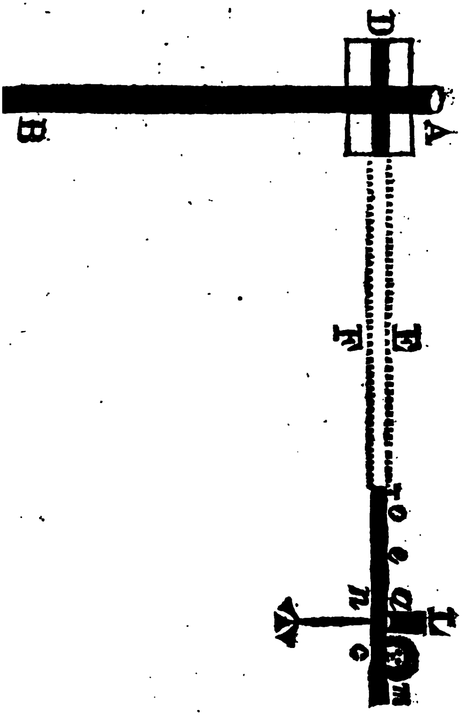
How to plum and dial in an open Rake, where there is many croſs Drifts and Turnings, and afterwards to ſquare the ſame above Ground.

FIRST plum the Shaft, Turn, Lob and Stumps if there be any, by the Directions afore-delivered, chuſing that Point for your Square which you judge goes neareſt croſs to Rake or Pipe; which ſuppoſe here to be 28; and take all your croſs Lengths upon that Point, till ſuch Time as you have done plumming, unleſs it happen that your Plummet falls upon the End of the Shaft, or Turn, as you plum; If ſo, then take a new Square to this Square of 28, as you did in the laſt Example before, or the neareſt it you can; ſetting down the Length and Points in order: Now ſuppoſe you come to take a Length forwards into the Drift at the Shaft-foot, having firſt made a Mark there where the Plum fell, let a Boy hold one End of the String therein, and bid anoth[illegible] Man take the Plummet, and go as far back into the Drift as he can, till the Plum he hath in his Hand touches the Side; and ſtretching the String ſtreight, obſerve that it touches no where betwixt that End he holds in the Mark, and the Plummet the other Man hath in his Hand, (if it touches the Side bid him come nearer) then apply the *Dial* to the Side of the String, and when the String and *Dial* lie exactly ſtraight together, take the Point the Needle ſtands on, which ſuppoſe here to be 44: Set down the Point, bid him make a Mark at the Plummet: Then pull back the String and meaſure it; which ſuppoſe here to be 12 Rules and 14 Inches: Then go to the Mark he made, hold one End of the String in it, bid him go back into the Drift with the Plummet as far as he can, till the middle of the String begins to touch the Side; then ſtretching the String ſtraight, obſerve that it touches no where betwixt them that hold it, apply the *Dial* to the Side of it, and take the Point the Needle ſtands on, which here ſuppoſe to be 50; ſet it down, bidding him make a Mark at the Plummet; pull back the String and meaſure it, which ſuppoſe here to be 8 Rules and 6 Inches; which ſet down over-againſt the Point: Then go to the laſt Mark he made, hold one End of the String therein, bid the other go back with the Plum as far as he can, ſtretching the String ſtraight, obſerve that it touches no where on the Side betwixt them that hold it; apply the Side of your Dial parallel to the String, and take the Point the Needle ſtands on, which ſuppoſe here to be

48; ſet it down, bid him make a Mark at the End; pull back the String and meaſure it, which ſuppoſe here to be 14 Rules and 8 Inches; then go to that Mark, and laying the String out as before directed, take the Point there, which ſuppoſe to be 52; ſet it down, and making a Mark at the End, let this be the Fore-field of your Work: Pull back the String and meaſure it, which ſuppoſe to be 16 Rules and 10 Inches: Then go up to the Day, and having gone over the Lengths and Points you took in plumming the Shaft, and found the Mark above Ground you made at the Shaft-foot, (which you may do by the Rules and Directions already delivered,) meaſure out your firſt Length, 12 Rules and 14 Inches, hold one End of the String in the Mark, bid the other Man go forwards with the Plummet, then do you ſet the Needle upon 44, (and bid him wave the String to and fro, till it lies exactly ſtreight with the Side of the Dial,) the Needle ſtanding upon that Point, bid him make a Mark there; and ſo you have done your firſt Point; and in like Manner you muſt do all the reſt following, 'till you find the Place above Ground right over the Mark you made at the *Fore-field* below; which done, make a Mark, and drive down a *Stake*. Now if you would know how far you are driven in your Meer, you muſt ſquare the Ground above; therefore tie one End of your Cord to this *Stake*, and bid him go croſs with the other End, 10, 20, or 30 Yards, more or leſs, as you think good; ſet the Needle upon 28, which was the Square you took when you firſt began to plum the Shaft, and do you ſtand in the Middle (betwixt him that holds the String, and the *Stake*) with the Dial, bid him move the String to and fro, or do you ſhift, if you ſee Cauſe, 'till the String lies exactly ſtreight, and equally even with the ſide of the Dial, the Needle being preciſely upon 28, bid him make a Mark at the End, drive down a *Stake* there, and pulling the String ſtreight, faſten it to the *Stake* and leave it: Then come back to the Shaft, having another String ready, put one End to that Place of the *Stows* from which you firſt began to plum, ſet your Needle upon that Point, which is exactly ſquare to that Square you took when you firſt began to plum the Shaft, which was 28; therefore the Point that ſquares it is 44: Then let him go forwards with the String upon that Point, 'till the String he hath in his Hand croſs the String you faſtened betwixt the *Stakes*, go you into the Middle, and apply the Dial to the Side of the String, bid him move it up and down 'till the Needle ſtands exactly upon 44; then bid him make a Mark where the Strings croſs one another and drive down a *Stake* there; ſo the Diſtance meaſured from this *Stake* to the *Stows* is the true Length of your Ground driven.

How to Plum and Dial, and bring up Soughs, Drifts, or Addits, to hit any Place or Depth deſired; and to know whether a Sough begun, will lay a Mine dry or not.

HAVING firſt plumb'd your Shaft, Turn, Lobs and Sumps by the Rules afore-delivered, and knowing the Depth thereof: Becauſe few or any Miners underſtand a *Quadrant*, the Inſtrument for this Purpoſe may be like the following, *viz.* A Water Stand, with one or more Channels; which the Miner may make himſelf, upon an old ſeaſoned Joyce, cutting a Morteſs therein a Yard long, or more, as his own Diſcretion directs, plaining the ſame very well and even.


D
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Having the Inſtrument ready, and a Staff or Pole of 5 or 6 Yards long, which you may call the Perpendicular-pole; as A B repreſenteth: D the Mark levelled at: *m* the Leveller looking over the Channel: *a* the Hole above the Channel of Water, through which the Leveller looks: *e* the Channel full of Water: *o* the Pin at the End of the Channel: *n* a Piece of Wood with three Iron-forks at the End, to ſtick in the Ground: L a Board ſet up croſs over the Channel, having a little ſlit under it, as at *a*: E F the Levelling-Line.

Suppoſe you be called to Level a Piece of Ground, to know whether it will lay dry a Mine (by a Sough) that is to be began in any Place appointed.

Firſt, view over the Ground, then erect your Inſtrument at the Mine, and cauſe ſome one to take the Pole, and to go as far towards the Place where you intended to begin your Sough, as the Length of your Pole will admit; then ſee that the Water ſtands even in the Channel: Look through the Slit at *a*, and bid him ſhift the Pole to and fro, 'till you ſee the Pin at *o*, interpoſe your Eye and the Mark you level at, as D: which done, bid him make a Mark at the Foot of the Pole; and ſhift your Inſtrument thither, and erect it there, ſetting down the Length of your Pole in Yards and Inches: Then do as you did before, 'till you have finiſhed the Whole, and come to the Place where you intended to begin your Sough: Then reducing your Poles into Fathoms, compare them with the Depth of your

Mine, and thus you may know whether it will lay it dry or no.

Naturam ubiq; compendium amare :
Senſibus hæc imis (rès non eſt parva) repone.

Ingraft theſe Precepts deep within your Senſes,
The Matter's good, and got by ſmall Expences.

From my Lodgings near
Apothecaries Hall in *Black*
Fryars, *London*. Feb. 8,
168$\frac{0}{1}$.

F I N I S.

The laſt Operation in Dialling.

Depth,		*Points.*	*Length.*	
Ru	*Inch.*		*Ru*	*Inch.*
00	00	28	00	00
00	00	44	12	14
00	00	50	08	06
00	00	48	14	08
00	00	52	16	10

AN EXPLANATION OF THE MINERS TERMS of ART Uſed in this BOOK.

BAr-maſter, is he which keepeth the Gage or Diſh to meaſure all Miners Oar, he or his Servant being preſent when meaſured.

Brazen-Diſh, is the Standard by which the other Diſhes are gaged, and is kept in the King's Hall.

Cavers, are any poor People that go about the Mines to beg or ſteal Oar from the Miners.

Coes, are little Houſes which the Miners make over their Mines to lay the Oar in.

Cope, is 6*d*. for every Load of Oar, nine Diſhes making one Load.

Croſ

Croſſes, are two Nicks cut on the Superficies of the Earth, thus ✢ which the *Miners* make when they take the Ground to dig for Oar; This Croſs gives the *Miners* three Days Liberty to make and ſet on *Stows*: As many of theſe Croſſes as the *Miner* makes, ſo many Meers of Ground he may have in that Vein, if he ſet on *Stows* within three Days after the making his Croſs or Croſſes; but if he make but one Croſs, and a Stander by makes the ſecond, and a Stranger makes the third, every one is ſerved with the next Meer, according as they have firſt or laſt, ſooner or later made their Croſs or Croſſes upon the Ground.

Diſh, is a Trough made of Wood, about 28 Inches long, 4 Inches deep and 6 Inches wide; by which all *Miners* meaſure their Oar: If any be taken ſelling their Oar, not firſt meaſuring it by the Bar-maſter's Diſh, and paying the King's Duties, the *Miners* incur that Forfeiture which the 17th Article has impoſed upon them.

Drift, is a Paſſage thus cut out under the Earth betwixt Shaft and Shaft, or Turn and Turn, or a Paſſage or Way wrought under the Earth to the End of a Meer of Ground or Part of a Meer.

Farmer, is the Lord of the Field; or one that farms the Lot and Cope of the King.

Fodder of Lead at the Mines contains Twenty-two hundred and a half weight, though in *London* but Twenty hundred Weight.

Foreſtid Oar, is Oar that is gotten out of Earth and Dirt that hath been waſhed and Oar taken from it before.

Forfield is the furtheſt Place that a Man has wrought in his Ground ; or the End of a Meer above Ground.

Groove, is the Shaft or Pit ſunk into the Earth ; they are ſometimes ſunk in the Vein and ſometimes out.

Hack, is a Tool that *Miners* uſe like a Mattock.

Hade, is where any Shaft or Turn goes deſcending like the Side of a Houſe, or like the Deſcent of a ſteep Hill, then it is ſaid to hade.

Load, is nine Diſhes of Oar ; each Diſh being about half a hundred Weignt.

Lobs, are Steps that aſcend or deſcend within the Mines, as Stairs up to and down from a Chamber.

Lot, is the 13th Diſh, Meaſure or Part of the *Miners* Oar, which the Bar-maſter takes up for the King or the Farmer.

Meer, contains Twenty-nine Yards in length in any Vein.

Meer-ſtake is a Pin of Wood drove into the Superficies of the Earth, to ſhew the Extent or End of a Meer of Ground.

Old Works, are ſuch that are either fallen in or ſtand unwrought.

Pipe, is where the Oar runs forwards endways in a Hole, and doth not ſink downwards or in a Vein.

Pee, is where two Veins meet and croſs one another thus ✢ the Place where they meet is called the *Pee*.

Poſſeſſion, is the right to a Meer of Ground, which *Miners* enjoy, by having *Stows* upon that Ground; and it is taken generally for the *Stows* themſelves; for it is the *Stows* that give Poſſeſſion.

Pawn, is a Pledge of Money put into the Bar-maſter's Hand at the Time when the Plaintiff cauſes the Bar-maſter to arreſt the *Mine*.

Pick, is a Tool the *Miners* uſe to cut down the Cliffs and Rocks of Stone to make Paſſages in the Earth.

Rither, is a Stone or thin Cliff that lies in the Vein; the Oar ſometimes runs on both Sides it; ſometimes this *Rither* is ſo thick, it parts the Vein, and makes one Vein two.

Quarter-Cord, is ſeven Yards and a Quarter, which the *Miner* hath croſs ways of his Vein on either Side; for Liberty to lay his Earth, Stones, and Rubbiſh on, and to waſh and dreſs up his Oar.

Rake, is the ſame with a Vein.

Shaft, is the ſame with a Groove or Pit; they are ſunk ſome ten, ſome twenty Fathoms deep into the Earth, more or leſs.

Stows, are ſeven Pieces of Wood (ſet upon the Superficies of the Earth) faſtened with Pins of Wood together; two are called *Soul-trees*; two *Stow-blades*, two *Hang-benches* and a *Spindle*: Theſe *Stows* give a *Miner*, or any Perſon that owns them, as good Right to a Meer or Meers of Ground, (ſo that every Meer have a Pair of *Stows* ſet on them) as a Deed of Conveyance doth to any Purchaſer.

Stool, is where the *Miners* leave digging deeper, and work in the Ends forwards; the End before you is called the *Stool*.

Spindle, is a Piece of Wood faſtened into either *Stow-blade*.

Smytham, is Lead Oar ſtamp'd and pounded down, like Powder or Sand, to cleanſe the Stones and Earth from the Oar.

Sough, is alſo called an *Addit*; it is a Paſſage like a Vault cut out under the Earth, to drain the Water from the Mines.

Smelting houſe, is a Houſe where they run and melt the Oar into Lead; one of theſe will run a Ton in ten or twelve Hours: A Fodder is their uſual Day's Work; that is, Twenty-two hundred and an half weight.

Sumps, are Holes ſunk in *Drifts* to the Depth of two or three Yards, more or leſs.

Twenty-four Men, they are Twenty-four Men choſen every half Year to redreſs the Grievances of the *Mines* and *Miners*; but every Man generally ſerves his Year when choſen.

Next Taker, is he that makes the next Croſs, or he that hath the next Meer in Poſſeſſion.

Turn, is a Pit ſunk in ſome Part of a Drift; if the *Mine* be deep, there is many of theſe *Turns* one below another.

Vein, is that which is bounded with *Woughs*, and contains Oar, *Spar*, *Cauck*, *Clay*, *Chirt*, *Croil*, *Brown-hen*, *Pitcher-chirt*, *Gur*, which the Philoſophers calls the Mother of Metals, and Soil of all Colours ſometimes. When it bears Oar it is called a quick *Vein*, when no Oar a dead *Vein*.

Woughs, are the Walls or Sides ſometimes of hard Stone, and ſometimes ſoft; when ſoft, then the *Miners* ſay they are rotten: Theſe are the Bounds of an Entry. Betwixt them all Sorts of Earth, Stones and Oar lieth, or, as Philoſophers ſay, groweth.

The End of the Explanation.

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